OR/
ODOT
INSTRUC
1919

OREGON STATE HIGHWAY
DEPARTMENT

MANUAL OF INSTRUCTIONS
TO
DEPARTMENT EMPLOYEES

MAY 1, 1919

HERBERT NUNN
STATE HIGHWAY ENGINEER

OREGON STATE HIGHWAY
DEPARTMENT

MANUAL OF INSTRUCTIONS
TO
DEPARTMENT EMPLOYEES

MAY 1, 1919

LIBRARY/INFORMATION RESOURCE CENTER
OREGON DEPT. OF TRANSPORTATION
RM 22 TRANSPORTATION BUILDING
SALEM, OR 97310

HERBERT NUNN
STATE HIGHWAY ENGINEER

TABLE OF CONTENTS

	PAGE
Introduction	3, 4
Reports to be submitted	5
General instructions for all employes	6–12
General	6–8
Purchase of equipment and supplies	8, 9
Printing	9
Automobiles	9, 10
Equipment	10–12
Auditing of claims	13–24
General	13–15
Workmen's compensation act	15–17
War tax exemption	17
Payrolls, preparation of	18–21
Expense accounts	21–23
Meals and lodging statements	23
Mileage or scrip books	24
Cost keeping	25–39
Method of cost distribution	25–29
Tabulation of account numbers	30–39
Instructions to locating engineers	40–57
Reconnaissance	40, 41
Preliminary line	42–46
Projection	46–48
Location	49–51
Reports	51, 52
Final records	52–57
Instructions to resident engineers	58–93
Grading work	58–64
General	58–64
Paving work	64–74
General	64–66
Superelevation of curves	66, 67
Asphaltic concrete pavement	67–71
Concrete pavement	71–74
Bridge work	74–84
General	74–76
Materials of construction	76
Foundations	77, 78
Steel structures	78–80
Concrete structures	80–84
Wooden structures	84
Reports	85–90
Final records	91–93
Federal aid projects	94–107
Regulations governing the general procedure on post road projects	94–98
Standards governing the form and arrangement of plans for post road projects	98–103
Regulations governing the general procedure on forest road projects	103–107

MANUAL OF INSTRUCTIONS

FOR

EMPLOYEES

INTRODUCTION

The object of this manual is to acquaint new employees with the requirements of the Department as well as to afford a concise and ready reference for older employees to matters covered by circular letters or instructions on specific situations, and to anticipate questions which may come up in the course of the work.

In addition, instructions are given covering engineering features, in accord with the best engineering practice. A further object of this manual is to standardize the work, to the end that all employees will handle their work in a uniform manner, and know what is expected of them. While some of these instructions may seem elementary and unnecessary, they are as a rule based upon points where mistakes and differences of methods and practice have been most frequent in the past.

It is not intended, however, to cover in this manual every possible contingency that may arise in the field or in office work, but to state the points on which strict uniformity is necessary and to indicate methods and forms which will produce the desired results insofar as it is possible to secure that uniformity.

While in the employ of the State Highway Commission, one is expected to accomplish two things: First, secure well executed work. Second, secure the cooperation and support of the people of the community in which the work is situated. One must bear in mind that his actions will govern the opinion the local people will form, not only on the piece of work in hand, but of the whole conduct of the Department. Employees should, therefore, see to it that this opinion is favorable insofar as strict attention to work and a businesslike and courteous manner on his part can form such an impression.

Good sense will indicate the folly of mixing in or becoming party to local political disputes or differences of any character whatever. Employees should always give courteous attention and consideration to all inquiries for information, and endeavor to furnish any data that they may have, or refer the question to the General Office if so desired. If the policies of the Commission, the plan of the work, or the methods required by the specifications, are at all in question, this should be explained that these are part of the instructions and that they can not be changed except by instructions from the General Office.

It might be suggested that the employee is not expected to burden his memory with the detail of these entire instructions, but should familiarize himself with their general provisions, and consult them frequently for specific instructions concerning any particular work at hand.

It is realized that various conditions may arise in the field work which will require different methods. These instructions are not intended as hard and fast rules, but as a guide to secure uniformity and completeness of records, together with the best results at a minimum cost. Employees will be judged by this standard. Any suggestion of improvement in the method of work or form of record will be appreciated at any time. It is necessary for everybody to cooperate to make the work of the Highway Department successful.

REPORTS TO BE SUBMITTED

No. of Copies for General Office.	Name of Report	Time of Submission	Form No.	Instructions on Page.
1	Weekly Reports	Every Saturday	39	51–85
1	Equipment Inventories	End of each month	48	10
2	Payrolls	End of each month	51	18
2	Expense Accounts	End of each month	16c	21
2	Bills and Invoices	End of each month or when transaction is completed	.....	14
1	Pay Check Receipts	Upon receipt of checks.		
2	Monthly Estimates	20th of each month	23	85
1	Monthly Quantity Summary	With monthly estimates	42	88
2	Force Account Orders	As made up	24	89
2	Force Account Bills	With monthly estimates.		
1	Material Receipt Duplicates	End of job	53	93
1	Daily Reports on Paving and Macadamizing	Each day	32	85

GENERAL INSTRUCTIONS FOR ALL EMPLOYEES

GENERAL

REPORT ADDRESS:

Upon being assigned to take charge of a piece of work, the employee immediately upon reaching his permanent headquarters for that work, should report to the General Office his post office, telephone or telegraph address; also location of nearest express and freight office. He should leave his name and address at the telephone, telegraph, post office, freight and express offices, and make sure that they understand where he can be reached. The General Office should at all times be able to locate employees promptly by letter or by wire.

Acknowdedge receipt of all instructions and supplies promptly. Report all important matters to the General Office in writing rather than verbally.

CORRESPONDENCE:

It is absolutely necessary for the General Office to be fully in touch with all business transactions and other matters of an executive nature on the work under its direction. To accomplish this it is expected that field employees will take up everything of importance with the General Office, before final action is taken, except in such cases as constitute a real emergency and require immediate action, when reports in full covering them should follow.

All correspondence, telegrams, freight and express packages for the General Office should be addressed to "Herbert Nunn," State Highway Engineer, Salem, Oregon, and never to individual employees. However, a notation may be made on the package or letter, "Attention (of some Employee)".

Official correspondence by field employees with those outside of the Department should be signed by themselves above their respective titles, and copies mailed to the Division Engineer in charge. This refers to minor matters of detail only. All advertising for contracts, purchases, right of way matters and other correspondence of any executive nature binding the Department in any manner, should come from the General Office only. To facilitate filing, each letter, so far as practicable, should cover but one subject.

TELEPHONE AND TELEGRAPH:

Employees should use the long distance telephone or send telegrams when matters of importance require it, but this should not become such a habit that telegrams will be sent or long distance telephone used when a letter would accomplish as good results.

SALARIES:

All salaries will be fixed by the State Highway Engineer, and will be stated in such terms as to allow in addition all necessary expenses, or traveling expenses only, or may preclude all expenses, according to conditions and arrangements made with the employee, in writing at the time of his employment. Payrolls will be checked from this salary list, and unless there is written authority from the State Highway Engineer to the contrary, only the rates on this salary list will be allowed. The title of each employe should be definitely stated on the payroll and the expense accounts.

When it is considered advisable to change the rate of an employee, a letter from his immediate superior making such recommendation, with a full statement of the facts in the case, salary recommended and desired, and effective date, should be sent to the General Office in sufficient time for action prior to date recommended for the new salary to become effective, and no definite promise should be made to the employe until action on the request is known.

TRAVELING EXPENSES:

When employees working on a monthly basis are engaged, their time will start the day they start for the job; and in general they will be reimbursed for the traveling expenses, which will be decided in each individual case, and included in their letter of instructions. Employees transferred at the instance of the Department will receive full expenses and time while making transfer. When work is completed, and if necessary to lay men off, they will be entitled to expenses back to the point where they were hired. This will not apply to men working on a per day basis. It is the desire of the Department to keep good men in the service, and on work nearing completion, the General Office should be advised of men available for other work.

TRANSFERS:

When transferring men from one job to another, a letter of introduction should be given, showing the date to which the employees' time is carried on the payroll of the first job, so that he will receive full time if he is entitled to it. In general, time consumed in traveling from one job to another will be charged to the second job.

LEAVE OF ABSENCE:

When field employees are to be away from their designated headquarters, authority should be requested from the State Highway Engineer in advance, and they should not report to the General Office on what they consider official business without this authority. A statement as to why it is necessary to leave designated headquarters should be made, and if the case is urgent, authority may be granted by wire.

ITINERARY LISTS:

Employees who have headquarters at the General Office should, when about to start on a trip, furnish route list showing itinerary, dates, and if possible, name the hotels at which stops will be made. A copy of this list should be retained by the traveler, and if, during the course of his trip, the itinerary is materially changed, a revised list should be mailed or wired to the General Office.

COPIES OF CORRESPONDENCE, ETC:

Copies of all correspondence, reports, payrolls, expense accounts, invoices, etc., should be retained by the employee for his own records.

REVISION AND ADDITIONS:

All revisions and additions to the instructions in this manual will be issued in the form of circular letters, beginning with Number 1.

PURCHASE OF EQUIPMENT AND SUPPLIES

REQUISITIONS:

Supplies and equipment will be obtained by requisition on the General Office, except in cases of extreme emergency or where special authority is given to purchase locally. Emergency purchases should be explained by letter.

Requisitions should be made out fully and carefully, giving sufficient descriptive matter, names, styles, numbers, by whom manufactured (if special make is desired), etc., so that there may be no doubt as to exactly what is desired. They should bear the approval of the one in general charge of the work, and mailed to the General Office.

Requisitions should also state how shipment is desired, by freight, express, or parcel post.

Requisitions will be filled from stock supplies where possible, and in case it is necessary to purchase outside, the employe will be furnished a copy of the purchase order so that if prompt delivery is not made, he may take it up with the dealer direct.

All stationery should be ordered by form number.

PURCHASES MADE BY GENERAL OFFICE:

On purchases made direct by the General Office, invoices will be mailed to the employee ordering the goods, and as soon as goods have been received and checked off, invoices

should be promptly returned to the General Office, properly O. K.'d with distribution to the job and account numbers, and with notation as to discrepancies, if any. Employees who O. K. bills should sign their names and titles, not just their initials. Please note that invoices are not to be held until the end of the month, but should be sent in just as quickly as possible after their correctness is determined.

LOCAL PURCHASES:

On such local purchases as may be authorized by the General Office, invoices should be secured in triplicate; the original and duplicate to be sent to the General Office and the employee incurring the obligation keeping the triplicate copy for his files.

PRINTING

The law provides that all printing for State Departments be done by the State Printer, so all printing will be handled by the General Office.

AUTOMOBILES

HIGHWAY DEPARTMENT GARAGE:

The Commission maintains a well equipped garage in Salem for the repair of department cars, and it is the intention to overhaul and repaint each car at least once each year. When a car is in such condition that it requires a general overhauling or major repairs, the General Office should be notified, and arrangements will be made to either bring the car to Salem, and furnish another car, or give authority for the repairs locally. It is desired to do as much work as possible in our own shop, except in cases of emergency. For cars working at considerable distance from Salem, it is, of course, preferable to have repairs made locally.

SPEEDOMETERS:

Employees should keep their speedometers in working order to the end that a record of the mileage of the car may

be obtained. Reports of mileage will be made on expense account forms. The General Office keeps a record of the costs of operation of each car, and for that reason each invoice or expense account in connection with automobiles should show the Department number of the car.

ECONOMICAL OPERATION:

Each employee in charge of a car should give particular attention to its economical operation. It is found that there is a vast difference in the cost of operation of cars in practically the same district, and it is apparent that the more economically operated car must be in the hands of a more careful and intelligent driver.

CASINGS AND TUBES:

Casings and tubes can be obtained on requisition. Except in cases of emergency, casings and tubes should not be purchased locally. By purchasing in large quantities, the Department is able to buy at dealers' prices. Employees should note the mileage secured from casings, and if the guaranteed mileage is not obtained, the matter will be taken up with the dealers for adjustment. A vulcanizing outfit is maintained in the general garage, and casings and tubes in need of repairs may be sent in, preferably by parcel post. There is no objection to vulcanizing being done locally if the charges are reasonable and the workmanship good.

EQUIPMENT

INVENTORY:

An inventory of equipment on hand is required on the first day of each month. Equipment rented or borrowed should be so marked. The statement should show dates on which equipment is received, from whom, disposition and date, or, if on hand, its condition.

Items of engineering equipment should be reported as listed on special form. The major items of construction equipment should be listed, except that items such as cookhouse outfit, complete for fifty men, blacksmith outfit complete, may be listed as such and need not be shown in detail. When any equipment is lost, destroyed, broken or stolen, a full report covering the circumstance, with the name of responsible employee should be made. Loss or breakage due to carelessness, will be charged against the person responsible.

The equipment inventory should be made in duplicate, the original copy to the General Office and one copy kept by the one making the report to enable him to check up each month's statement with the one previous and explain discrepancies.

When the employee in charge is transferred or leaves the service, he should write up an inventory covering all items with which he is charged, and secure a receipt from his successor, which should be mailed to the General Office. At the completion of a job, when equipment is returned to Salem, a similar receipt will be given.

RENTAL CHARGES:

A monthly rental charge for automobiles, transits and levels is made against the job on which they are in use, from the time they leave the General Office until they are returned or transferred to another job. Hence, it is to the interest of employees in charge to turn in property promptly at the close of the job or promptly report transfers.

Miscellaneous items of small equipment, such as level rods, hand levels, range poles, etc., are charged against each job at their value when sent out. When equipment is returned or transferred, credit is given to the job.

CONSTRUCTION EQUIPMENT:

Construction equipment such as trucks, rollers, crushers, track cars, pumps, engines and other pieces of heavy equipment, are charged out on a monthly rental basis. Tents, small tools, drill steel, wheelbarrows, etc., are charged against each job at their value when sent out, and a credit allowed for all items when returned. Thus it will be seen that these items of tools, etc., should be charged to the job if purchased new, and if turned in on completion of the job, the job will receive proper credit.

All expenditures for repairs, supplies, fuel and transportation will be charged to the job. When equipment and supplies are shipped from one job to another, the transportation will accrue to the second job.

AUTOMOBILES AND TRUCKS:

In the case of automobiles, tires used will be charged to the job. In the case of trucks, all solid tires will be charged to equipment to insure a fair distribution, and a sufficient rental will be charged to cover. In all cases where rental is charged, a sufficient sum is charged to cover depreciation, and overhauling and general repairs when returned to headquarters.

STOCK:

Items carried in stock at the General Office, such as stationery, engineering supplies, etc., are charged against each job or department as issued.

GENERAL WAREHOUSE:

An inventory of equipment and tools on hand at the General Warehouse, will be kept up to date, and requisitions will be filled from supplies on hand insofar as it is possible to do so. For this reason, equipment for which you have no further use on a job should be reported at once, so that it may be used elsewhere if desirable.

When rented or loaned equipment is returned direct to owner, a letter notifying him of such action should be mailed the same day as equipment is started, a copy of which should be mailed to the General Office with copy of express or freight receipts. Sufficient description, with dates, numbers, sizes, names, etc., should be made on the equipment records to readily identify the articles.

AUDITING OF CLAIMS

GENERAL

CLAIMS ARE AUDITED BY SECRETARY OF STATE:

As a matter of information, it is advisable to touch upon the necessity of following carefully all instructions outlined herewith. As is well known, all accounts incurred by the Highway Department must be finally passed upon by the Auditing Department in the office of the Secretary of State before warrants will be issued. When vouchers are sent to the Secretary of State, if they are found not to conform to the requirements of his office in every way, the issuance of the warrant will be delayed until the necessary data can be secured, and no claim will be paid until it is in proper form.

The Secretary of State is guided wholly by the Constitution of the State and the Laws enacted by the Legislature, and is under heavy bond to insure compliance with the requirements of these statutes; so neither the Highway Department nor the Secretary of State has any option in these matters, but must "hew to the line," as provided by the Law. These facts should be borne in mind when the General Office sends out inquiries for further information on accounts. It is for the employees' benefit and to avoid delay that it is necessary to insist upon having full information in preparing accounts for presentation to the Secretary of State.

APPROVAL BY COMMISSION:

All vouchers prepared must be approved by the State Highway Engineer and by the State Highway Commission before being passed to the Secretary of State for auditing. The State Highway Commission holds its regular meeting on the first Tuesday after the first Saturday of each month. In order to have attention at this meeting, the accounts must reach the General Office in time to be vouchered. The Commission calls special sessions occasionally during the month. At these sessions whatever vouchers may be ready for action are examined. All accounts, therefore, should be sent to the General Office as soon as the transactions they cover are closed, and not necessarily held until the end of the month. If they are sent in immediately after they have been received and O. K.'d, it will insure payment more promptly.

CAREFUL PREPARATION NECESSARY:

The General Office is not arbitrary in its requirements for the vouchering of accounts. If each employe in charge of work will spend some time learning the State requirements, and cooperate, all accounts may be paid with reasonable promptness and considerable dissatisfaction avoided.

All accounts should be returned in such shape that one not familiar with the Highway Department and the work which is being done can intelligently check all items.

FORM OF INVOICES:

In form, invoices must be itemized to show date article was purchased, total quantity, unit price and cost extended in every item possible. Those covering repair work on equipment, automobiles, etc., should show in addition to the date, hours of labor performed and rate per hour. Labor and material entering into repair work must be itemized separately, except in case of vulcanizing tires, or similar work, which may be considered a job. The particular piece of equipment should be noted, and in the case of automobiles or trucks, the Department number should be added. In short, add such explanation as is necessary to make every item clear, or it may be returned for further information.

PAYMENTS OF ACCOUNTS:

The General Office will be enabled to make payment of accounts much more promptly if field men, when making purchases will secure the invoice at the time of delivery of goods, O. K. it, insert proper account number and transmit to the General Office at once. When this is found impracticable, then the invoice should be rendered at as early a date as possible, which will assist in expediting payment. The people with whom we do business are, as a rule, unfamiliar with the State's requirements in this matter. They furnish the materials, expecting that the man who makes the purchase also makes payment, and knows all about the transaction. Sometimes they do not render invoices or make any effort to secure payment until there has been considerable delay; then they commence to inquire about their claim and complain about the Highway Department's slowness in making payments. If the country merchants will not do their part and promptly render invoices, they should be reminded and the invoice should be secured and sent to the General Office for payment. A little time spent occasionally in explaining to them the methods of handling State business, the volume of the work of the State, which but few appreciate, and the fact that on account of this volume of business it is necessary to have departments and a rigid system of handling accounts or the taxpayer himself would be the loser, would be time well spent.

PREPAYMENT OF FREIGHT AND EXPRESS:

In all cases where prepayment of freight or express has been made, the original freight or express bills must be attached to the invoices.

PREPARATION OF VOUCHERS:

Vouchers will usually be prepared in the General Office, but to expedite payment of claims, blank voucher forms will

be furnished to employes in charge, and in cases where it is desirable to do so, the invoices may be attached to the voucher and the voucher signed and acknowledged before being sent in to the General Office.

ALL ACCOUNTS SHOULD BE IN DETAIL:

When accounts reach the General Office for vouchering, it is usually too late to write to the field for additional information and receive it in time to pass the account at the regular monthly meeting. Therefore, it is to the interest of employees to make accounts as much in detail and as clear as possible when first transmitting to the office, and to see that the above rules have been generally followed, or if not, that full explanation is given. Vouchers will be audited with the above rules as a guide, and if there are any reasons why they are not observed, full explanation should accompany the account, for consideration when the audit is made. Every employee who is authorized to incur expenses against the Oregon State Highway Commission should be thoroughly familiar with these general rules, and his ignorance of them will in no wise affect the auditing of accounts which he may submit.

CLAIMS MUST BE ACKNOWLEDGED:

All claims must be acknowledged before a Notary Public, Justice of Peace, or County Clerk. Acknowledgment by a Postmaster is not acceptable. No refund can be allowed for these charges. Acknowledgment is required only on the original voucher.

POLICY OF DEPARTMENT:

It is the policy of the General Office to handle the accounts with as little "red tape" as is possible, and it is believed that the State Highway Department requires no more "red tape," and probably considerably less, than the average large corporation or business establishment doing the same amount of business. Good business policy, however, demands that accounts be rendered in such a manner that an intelligent check can be made, and it is with this end in view that these instructions are promulgated and sent out. An employee's value to the Department is based on his understanding of the requirements of the Department, and his willingness to adapt himself to those requirements, as well as his ability to handle the work which is assigned to him.

WORKMEN'S COMPENSATION ACT

COST TO EMPLOYEE AND HIGHWAY COMMISSION:

The Department has elected to accept the terms of the Workmen's Compensation Law, and unless an employee,

within three days after beginning employment, gives written notice that he does not desire the benefit of this protection, he is automatically insured. The cost of this protection to the employee is one cent per day or fraction thereof, regardless of the position or the salary he receives, and this deduction should be made on the payroll. In addition to the deduction of one cent per day from the employee's salary, the Highway Commission pays for the protection afforded by the Compensation Law to the Industrial Accident Commission a percentage varying from one and one-half to six and one-half per cent of the employee's salary, depending, of course, on the hazard of his work.

REPORTS OF ACCIDENTS:

In case of accident, the forms, with which each party is supplied, should be made out promptly and sent to this office, and this applies to all accidents without regard to their seriousness.

MEDICAL AID:

If it is necessary to consult a Doctor, you are at liberty to go to the one most convenient, informing him that any services he may render, or supplies he may furnish are to be paid by the State Industrial Accident Commission. The Highway Department has no authority to pay for either medical attention or medical supplies. In the larger camps the Industrial Accident Commission furnishes first aid kits, which may be secured on application to this office.

When the employe is disabled and can not do his work, the matter of compensation for him during this period is entirely in the hands of the Industrial Accident Commission, and he should not be carried on the timebook of the State Highway Department. If it is necessary for him to go to a hospital, the Industrial Accident Commission will pay all expenses.

FORMS TO BE FILLED OUT:

Industrial Accident Commission Form No. 21, "Report of Accident, Employer's Statement," should be made out in duplicate immediately after accident has occurred, giving the hour accident occurred as nearly as possible, and if the employee is injured and unable to continue his work, his time with the State Highway Department should stop on that hour. Every item on this form should be carefully filled in; also the portion on the back of the form. The only part of this report not to be filled in by field employee is the following: "The firm name, signed by, title, business of employer, city, signed at, this ——— day of ———," which shall be made out at the General Office. The two lines "Witness to Accident" should be carefully filled out in the field. If there were no witnesses to the accident, it should be so stated. When properly filled out, this Form No. 21 should be sent immediately to the General Office in duplicate, whether or not the accident is considered serious. Fre-

quently slight accidents become serious later, in which event, if the report has not been filed, it is difficult to secure proper action through the Industrial Accident Commission.

Form No. 22 is the claim for compensation by the workman himself. This should be called to his attention, and he should be assisted in filling it out in duplicate, one copy to be sent to this office.

Form No. 23 is in three parts to be filled in by the Attending Physician, who is the representative of the Industrial Accident Commission. The statements made by the doctor, and Forms 21 and 22, should correspond. Whether or not the employee receives compensation depends largely on the physician's report.

Each party should have a few of these forms, and if they are not on the stationery list, requisition the General Office and they will be forwarded promptly.

WAR TAX EXEMPTION

STATE EXEMPT FROM WAR TAX:

The Federal Law providing for War Tax on railroad transportation, exempts the State government from the payment of this tax on passenger transportation, Pullman accommodations, express and freight transportation, telephone and telegraph.

Therefore, an employe of the Department, on official business, is exempt from these charges, and should claim exemption, and present an exemption certificate properly filled out. War Tax charges paid, can not, under any condition be refunded.

On all work done by contractors on a force account basis, exemption from the payment of war tax should be secured, because, if paid, they can not be refunded.

In making shipments of equipment or supplies chargeable to the State Highway Commission, it is necessary to have all shipments addressed to either Herbert Nunn, State Highway Engineer, or State Highway Commission, regardless of the point from which they are shipped. If shipments are to go to some field party, then the additional notation, "care of ———", can be made in the billing, but in all cases should show definitely that the shipment is for the State Highway Commission, in order to take advantage of the exemption from war tax. Blank exemption certificates will be furnished by the General Office.

PREPARATION OF PAYROLLS

LISTING NAMES:

The name of the employee with the first name in full and middle initial, should be entered and care taken to have it properly spelled. Then with care in copying subsequent timebooks it should remain the same. All names should be entered in alphabetical order.

MONTHLY RATES:

For men employed on a monthly basis when employed only part of a month, the amount due him is calculated as the total number of days employed, divided by the total number of days in that particular month, multiplied by the monthly rate. Uniform rates of salaries should be carried at all times. If a man is carried on a monthly basis and works only a few days, his rate should be shown on a monthly basis. It shall not be reduced to a day wage and should not come in at one time under a monthly rate and the next time under a daily rate which shows very clearly that a monthly rate has been the base taken to secure the daily rate.

EXTENSIONS AND RATES:

All extensions on accounts should be to the smallest unit, and five mills or over will be considered as the next cent. When extensions are not made in this manner it is necessary for the General Office to make changes. Rates may be shown as per hour, day or month but the rate per day or month is preferred where practical.

ACCOUNT NUMBERS:

On all pay rolls the proper account numbers should be inserted in the column provided for them, and each space under dates should be filled in, either with an "X" denoting a whole date, or the number of hours worked when only a portion of a day. Great care should be taken in selection of account numbers and segregation of time of men to these numbers in order to secure proper distribution of cost.

OVERTIME:

For general information there is noted herewith the following section from Laws 1913, Chapter 61, as amended by Laws of 1915, Chapter 165,

"In all cases where labor is employed by the State, county, school district, municipality, municipal corporation, or subdivision, either directly or through another, as a contractor, no person shall be required or permitted to labor more than eight hours in any one day, or forty-eight hours in any one week, except in cases of necessity, emergency, or where public policy absolutely requires it, in which event the person or persons so employed for excessive hours

shall receive double pay for the overtime so employed; and no emergnecy, necessity, or public policy shall be presumed to exist when other labor of like skill and efficiency which has not been employed full time is available; PROVIDED, HOWEVER, that the provisions of this section shall not apply to State institutions and departments." (Refers to Hospital, Prison, etc., only.)

STATE OF EMERGENCY REQUIRED:

This matter has been taken up with the Labor Commissioner and in order to pass emergency claims thru this office, it will be necessary for the Engineer, Superintendent or Foreman, to submit a statement covering fully the nature of the emergency on which overtime was necessary, and unless the timebooks are accompanied by this statement it will be necessary for us to allow only eight hours per day, and the one in charge of the work can explain the shortage to his man the best he can. This ruling does not apply, however, to employees on a monthly basis, and such employees are not to be allowed overtime, it being considered that their salaries are for the proper handling of the work they have in hand and if it requires overtime, there is no extra compensation.

EMERGENCY DECLARED BY COMMISSION:

Where an emergency has been declared by the Commission and the work is carried on a ten hour basis, of course, no further explanation is necessary.

DOUBLE RATE FOR OVERTIME:

There is only one way to handle the rates of men who are working overtime. All rates must be based on an eight hour day, and when the eight hours have been worked they should be entered on the payroll as eight hours or less on the eight hour rate. If overtime is worked, then the amount of overtime should be shown immediately below the eight hour time and the rate should be shown just double the rate of the eight hour day. These are two separate and distinct accounts and must be carried as such.

The pay roll should show this arrangement very clearly and the men should not be given double the amount of hours to cover overtime, but the rate itself should be doubled in every case, and this is the only way that overtime should be carried.

SUNDAY WORK NOT OVERTIME:

In connection with overtime work it does not seem to be very clearly understood that work on Sunday does not necessarily mean that men should be paid overtime. Sunday is the first day in the week. If a man works eight hours on Sunday he is not entitled to overtime until five additional days of eight hours have been worked that week, making a total of forty-eight hours for the week.

Only time that he puts in excess of forty-eight hours in one week is on the overtime basis, except that any time in one day over eight hours would also be considered overtime.

It seems to be the impression that if a man puts in a little time on Sunday, regardless of whether he works any other time or not, that he is entitled to double pay. This is not the case, and in hiring men from employment agencies they should be given the rate for the eight hour day and no statement made about overtime, as the employment agencies invariably get matters mixed up.

Owing to the wording of the law covering these cases, it is very important that these instructions should be followed to the letter, that our records may be in such form that the Highway Commission will not be open to censure for the method in which we handle this emergency work.

OVERTIME TO BE KEPT TO MINIMUM:

It should be remembered that overtime work should be held down to the minimum and advantage of this concession only be taken when it is absolutely necessary and to the best interests of the work.

TIME CHECKS:

When an employee is discharged or leaves the Deartment of his own accord, a time check should be issued, giving the number of days worked, rate per day, occupation, deductions, amount due the employee and account number distribution. The employee should sign his name on the face of the time check and have same witnessed by the timekeeper or the engineer. The timecheck should also be signed on the back by the payee, giving address to where the paycheck should be sent, and mailed to the General Office for issuing of check. Employees paid by time checks will be entered on the payroll in the usual manner with the notation "Time Check Given."

CLOSING PAYROLLS:

Towards the last of the month, all work on the closing up of the payrolls which can possibly be done in advance should have attention, that as little extra work as possible be left for the last day of the month. All payrolls should be mailed to the General Office complete in every detail, the last of the month. Each page of the payroll should be totaled by columns and a recapitulation by pages on the back of the last sheet of the payroll. A summary of charges by account numbers should also appear in the proper place on the back of the last sheet showing the total amount to each account number listed in numerical order. The total of the summary of accounts and the gross amount earned will balance if the extensions are correct.

SIGNATURES AND SUMMARY:

Each payroll should be signed by the Timekeeper and the Engineer. Each page should be numbered, and on the back of the final page a summary of the pages should be made. Payrolls should be submitted in duplicate.

DELIVERY OF PAY CHECKS:

The delivery of the salary checks for the various employees working for the State Highway Department, will be made personally or under the direction of the Auditor. Whenever practicable, he will take the checks in person and deliver them to each man on the job, verifying the amount, and dates worked by the employee. When the checks are mailed out to employees in charge, the checks which he is unable to deliver should be returned to the General Office promptly.

ASSIGNMENT:

Our method of handling payrolls makes it impossible for the time of employees to be assigned. The name of the employee in the services of the State must be carried on the payrolls and the check at all times must conform with the names and items entered on the payroll. If an employee does assign his salary, the check will be made out in his name and the one accepting assignment can get it cashed as best he can. The Department does not authorize this procedure.

GARNISHMENTS:

The Department will recognize and honor garnishments when made in due form and enforced by the proper officers. The matter of writing check, however, will be handled in the same manner as outlined in the preceding paragraph.

EXPENSE ACCOUNTS

AUDITOR RESPONSIBLE:

The auditor is responsible for the thorough and careful auditing of all accounts, and is to audit expense accounts on the basis of their being "actual, necessary and reasonable, while on official duty for the State Highway Department and away from official headquarters." The fact that certain expenses are reported to have been incurred has no bearing on the audit of accounts that he is expected to make. The Auditing Department is in position to intelligently pass on these accounts on a comparative standard, for the reason that from the handling of accounts from

many parties and individuals in various parts of the State, and the time spent in the field by the Auditor himself, it is possible to arrive at a reasonable allowance, and there will be no hesitancy on his part in pruning down expenses that appear out of proportion, unauthorized or apparently personal.

EXPENSE ACCOUNTS TO COVER TRAVELING EXPENSES:

Expense accounts should cover certain dates, inclusive, and everything within those dates should be included therein on the one statement, if possible, as checking out expense accounts when they run back into dates covered by previous statements causes confusion. They should only include such items as ordinary traveling expenses. When other obligations, such as purchase of equipment, continuous livery hire, board for party, etc., are incurred, the invoices should be O. K.'d, account numbers inserted and forwarded to the General Office for payment, except where they may be for a small amount in which case they may be included in expense accounts.

USE STANDARD FORMS:

Employes should use the standard form for expense account. Meals and lodging should be listed under the respective dates and the place should be noted. Lodging for the night should be reported on the evening date. The dates to be given are the dates on which the expense is incurred regardless of when paid. Miscellaneous travel expenditures should appear in the space provided for this purpose.

Include in the expense account nothing for any other employee who renders an expense account for the same period. Where the head of a party takes over the entire expense account of other members of the party these should appear under their own names, for instance;

Expense of self, and here show all expenses of self, listing in consecutive dates, and give the total expense account; then show expenses of "John Brown" paid by "John Green"; also showing Brown's expenses by consecutive dates on a separate sheet, combining the total expenditures on a final sheet, showing a segregation of items, distributed to the proper job and account numbers.

SHOULD BE CAREFULLY CHECKED:

No refund can be made for Notary charges and these should not be included.

Expense accounts should be closed promptly on the last day of the month and checked over before sending in to see that all receipts are attached. Distribution of charges to the job prefix and account numbers should be made without fail. Expense accounts should be rendered in duplicate.

RECEIPTS FOR CASH PAYMENTS:

For meals and lodging, no receipts are required when paid as a single item, but where hotel bills cover a period of a few days a receipt should be taken and itemized. No receipt will be required for railroad or boat fare. Receipts for expenditures less than $1.00 are not required, except express and freight items. Items of $1.00 and over require receipts except as noted above. Receipts should be written on bill heads where the claimants have them, which gives authority to the transacation. In other cases, the sub-voucher form which will be furnished on requisition, will be found convenient. Receipts for stage fare and auto hire should be taken if over $1.00 and points of origin and destination should be noted. In the case of auto hire, the distance and the rate per mile or hour should be stated so that the method of arriving at the charge could be determined and by comparison determine the reasonableness of the charge.

Charges for transportantion of all kinds should be given also origin and destination. Telephone and telegraph charges should state from where to where, and to whom. Receipts covering the purchase of supplies, gasoline, etc., should be itemized in full so that any one not familiar may make an intelligent check of the same and determine if it is a proper charge against the State.

Express and freight charges should state from where to where, and to whom; also a few words designating the articles on which paid. Charges for freight and express will not be recognized unless a receipted bill is attached.

Receipts should be attached to the expense account to support the claim. Each receipt should be numbered in the upper right hand corner and reference to this number made in the expense account. Duplicate receipts are not required.

MEALS AND LODGING STATEMENTS

These forms may be used either for the individual or for parties who are not traveling and are intended to serve as a record for the meals or lodgings secured, itemized by days. Where parties are taking meals at more than one place, care should be noted that dates do not conflict, as payment for more than three meals per day cannot be allowed. These forms will preferably be submitted to cover board and lodging accounts.

MILEAGE OR SCRIP BOOKS

RECORD OF TRIPS:

All employees who are furnished with mileage or scrip books, will keep a record of the coupons detached for each trip as well as the date. When the book is completely used, the statement should be mailed to the General Office. If the last item in the book, or the first item in the new book shows a portion of a trip, it may be carried as follows:

Feb. 1, 1919—Portland to Salem, completes book..... $ 1.00

Total book No. 201..... $30.00

Book No. 321

Feb. 1, 1919—Begin Book, balance, trip Portland-Salem, used on book No. 201, $1.00..... .50

When Commutation Books are used, each trip should be listed and dated, and the record sent in when the coupons are exhausted.

It is understood that all transportation should be used only for official business and only within the State.

COST KEEPING

GENERAL INSTRUCTIONS

GENERAL SYSTEM:

The system of cost keeping being used by the Highway Department is what is generally known as the "Account Number System." Each job is assigned a number called the "Job Prefix," and each item for which it is desired to secure a segregated cost is assigned a number called the "Account Number" for that particular item. "Job Prefixes" and "Account Numbers" are nothing more nor less than abbreviations, and they are used because they save time and space over what would be required were the names and items which they represent, used. They have other advantages in the way of furnishing an automatic sequence of related items, but the main purpose of their use is to save time and space in tabulation.

Every expenditure made by the Department must be charged under a "Job Prefix" and under an "Account Number," and when an expenditure is so charged, its cost distribution is complete, for the "Job Prefix" indicates the job and the "Account Number" indicates the particular detailed part of the work for which the expenditure was made. Thus, if a bill has noted upon its face "29g-645" we know that that bill covers an expenditure for "Hauling" in connection with macadamizing on the "Three Rivers Project" in Tillamook County. The cost distribution is made by the engineer or other employe ordering the particular expenditure, he having full knowledge of the purpose for which the expenditure was made, and therefore being in the best position to make the proper distribution. By him the "Job Prefix" and "Account Number" are indicated on the face of the bill or other form of claim upon which payment is to be made. When the bill reaches the General Office, the amount of the charge goes into the cost records under the job and item of cost indicated by the notation made in the field, and is there combined with all other previous expenditures on that job and on that particular detail of the work.

JOB PREFIXES:

Immediately upon receiving assignment to a new job, the engineer in charge will apply to the General Office for a "Job Prefix" for that job, stating in his application, the name of the section, the name of the Highway, the name of the County, the length and kind of work and the definite limits of same. A "Job Prefix" can cover only work within the limits for which it has been assigned, and when work is undertaken outside of these limits, or when work other than that for which the prefix was assigned is to be done

within these limits, then a new prefix must be obtained to cover the additional work.

ACCOUNT NUMBERS:

The account numbers to be used in cost distribution are listed at the end of these instructions. On any one job only a few of these numbers will be required, and it is important that before making any cost distribution, the Engineer look over all of the numbers, carefully, noting the general arrangement and sequence of numbers, and determining the group or groups of numbers which apply to his work.

Field engineers will make no charges to numbers from 0 to 299 inclusive. These numbers cover "Administrative and General Supervision" costs or what is generall called "Overhead Expense," and the Department's general equipment account, charges against which can be made only by the General Office. All other numbers are for field use, and the numbers to be used on different types of jobs are described in the following paragraphs.

ACCOUNT NUMBERS FOR SURVEYS:

Engineers on reconnaissance surveys will have no occasion to use numbers other than those from 300 to 309 inclusive.

On preliminary and location surveys, the numbers 310 to 319 and 381 to 389 should cover all desired cost distribution.

ACCOUNT NUMBERS FOR CONTRACT CONSTRUCTION JOBS:

All engineering cost on contract construction jobs will be charged to the numbers 340 to 369.

All other items of cost will be included by the numbers 420 to 439 and 540 to 549. All payments to the contractor will be charged to number 431, and no further distribution will be required either for contract items or for extra work. Under number 432 will be charged all material furnished direct by the State (or, on County jobs, by the County), where the contract provides that the contractor receive payment for placing only, the materials to be furnished to him, as, for instance, culvert pipe, cement or other material which it may be deemed advisable for the State to purchase direct. Under number 433 will be charged all items which may be furnished to the contractor, but for which he reimburses the state by deductions from his estimates, as for instance, the use of State equipment or material which the contract does not provide that the State shall furnish.

Under numbers 540 to 549 will be charged those items of cost which are entirely outside of the contract and for which payment is made direct by the State. Where work of this kind is handled "force account," it will be charged under number 431.

The costs of work to the contractor will not ordinarily be kept by the Highway Department. If, for some reason, however, the contractor's costs are desired, the methods and account numbers used will be practically the same as for State Force or Cost Plus work.

ACCOUNT NUMBERS FOR STATE FORCE WORK AND PLUS WORK:

On State Force Work and work done on the Cost Plus basis, the cost keeping will involve more detail, requiring in most instances the services of a timekeeper.

The Engineering costs will be covered by the account numbers 340 to 369. The construction costs will involve the numbers between 420 and 999, distributed over the following subdivisions:

Right of Way Costs	420 to 429
Special adjustment items	430 to 439
Superintendence and General Expense	450 to 459
Clearing and Grubbing	460 to 469
Excavation and Embankment	470 to 489
Drainage Structures (Span 10 ft. or less)	490 to 499
Bridges (Over 10 ft. span)	500 to 519
Miscellaneous Structures	520 to 529
Special or Unusual Work	540 to 549
Maintenance	560 to 579
Operating Quarry and Crusher	600 to 619
Operating Gravel or Sand Pit	620 to 639
Placing Broken Stone Macadam or Rock Base	640 to 649
Placing Gravel Macadam or Gravel Base	660 to 669
Cement Concrete Pavement	700 to 719
Asphaltic Concrete Pavement	720 to 739
Camp Construction and Operation	900 to 909
Corral Construction and Operation	940 to 949
Commissary	960 to 969

It will be noted that the account numbers under these various subdivisions have been assigned with the view of obtaining the costs of the important operations concerned, rather than the costs of the different kinds of labor, materials, supplies, etc. Particular attention is called to the necessity of distributing all expenditures for labor, materials, repairs, etc., over the various operations of which they are a part, except insofar as these items are given particular account numbers.

Under the numbers 450 to 459 will be charged only such items as it is impracticable to distribute over the various detailed operations involved in the work. At the end of the job, these general items will be prorated over the proper detailed items.

RECORDING OF COST DISTRIBUTION.

The recording of cost distribution consists in noting upon the face of every bill, payroll, voucher, expense account, and other similar statements used as a basis for money expenditure, the job prefix and account number against which the expenditure is to be charged.

It is not necessary, however, to distribute bills for extra work on contract jobs, as the desired detail of costs on these bills is kept track of by means of the extra work order numbers. Each bill for extra work should have noted upon it the contract number and the number of the extra work order.

THE ENGINEER RESPONSIBLE FOR THE COST DISTRIBUTION ON HIS JOB.

Every bill, payroll, etc., chargeable to a particular job, with the exception of a few overhead charges made in the main office, passes through the hands of the engineer in charge of the particular job, for his approval and for his distribution of cost. The keeping of costs on each job, therefore, devolves upon the engineer. He is the representative of the Department on the ground and is therefore, in the best position to know against what items the various charges should be made. The cost distribution for his job is entirely in his own hands, and if at the end of the job, there are apparent inconsistencies in the cost records, they will be due to his own negligence, as the cost records in the General Office are simply tabulations and summaries of the cost distribution as sent in by the Engineer on the individual bills.

HOW TO SECURE MORE DETAILED COSTS:

If the engineer on a job desires to secure more detailed cost subdivision than is given by the account numbers as listed, he may get any further subdivision he requires by adding a fourth figure to the account numbers listed. For instance, if under "Operating Quarry and Crusher" he wishes to have the cost of labor, powder, drill steel, etc., entering into the cost of "Excavation of Rock" (account number 604), he can assign 6041 to labor, 6042 to powder, 6043 to drill steel, etc. These fourth figures will be for field information only, and when the charge comes to the Main Office, the first three figures, only, will govern the entry on the cost records.

HOW TO TRANSFER ITEMS OF COST:

If after an expenditure has been made and charged to a particular prefix or account number, the item or items for which the expenditure was made is used for a purpose or on a job other than that contemplated when the charge was made, the charge should be transferred to the proper prefix or account number. This is accomplished in the General Office by means of a transfer voucher, and to have a

transfer made, the field engineer or timekeeper need only write in, stating why the transfer is desired and the charges affected.

HOW TO HANDLE DEDUCTIONS ON PAY ROLLS:

In making up payroll distributions, distribute the gross amounts earned over the account numbers involved. In the summary of account numbers, show the amount of deductions for board as a credit to the mess house, account number 908, and the deductions for industrial insurance as a credit to "Industrial Insurance" account number 457 on State Force jobs, or to "Salaries" direct on engineering work where no special number for industrial insurance is provided.

ACCOUNT NUMBERS

ADMINISTRATION AND GENERAL SUPERVISION

General Administrative Expense
Prefix 80

101. Salaries.
102. Travel expense.
103. Postage.
104. Office rental.
105. Light, heat, water, etc.
106. Freight and express.
107. Printing and binding.
108. Advertising for bids.
109. Telephone and Telegraph.
110. Photography.
111. Premium on employees bonds.
112. Auditing by certified accountants.
113. Consulting engineer expense.
114. Legal expense.
115. Supplies and equipment.
116. Miscellaneous.

State Highway Commissioners (Prefix 82)

Legal Department (Prefix 83)

Auditing Department (Prefix 84)

Purchasing and Equipment Department (Prefix 86)

141. Salaries.
142. Travel expense.
144. Automobile operation and upkeep.
145. Materials and supplies.
146. Equipment.
147. Telephone and telegraph.
148. Freight and express.
149. Postage.
150. Printing.
151. Miscellaneous.

Office Engineering Department
(Prefix 88)

General:

201. Salaries.
202. Travel expense.
204. Automobile operation and upkeep.

205. Materials and supplies.
206. Equipment.
207. Purchase of blue prints.
208. Printing.
209. Miscellaneous.

Drafting:

211. Salaries.
212. Materials and supplies.
213. Equipment.

Blue Printing:

215. Salaries.
216. Blue print paper.
217. Power.
218. Materials and supplies.
219. Equipment.
220. Credits for prints.

Cost Keeping:

221. Salaries.
222. Materials and supplies.
223. Equipment.

Bridge Engineering Department

(Prefix 90)

Design:

241. Salaries.
242. Travel expense.
244. Automobile operation and upkeep.
245. Materials and supplies.
246. Equipment.
247. Blue prints.
248. Printing.
249. Miscellaneous.

Inspection:

251. Salaries.
252. Travel expense.
254. Automobile operation and upkeep.
255. Materials and supplies.
256. Equipment.
258. Photography.
259. Miscellaneous.

Division Offices

Pendleton Office (Prefix 92)

Medford Office (Prefix 93)

261. Salaries.
262. Travel expense.
263. Automobile operation.
264. Office rent.
265. Light, heat, water, etc.
266. Telephone and telegraph.
267. Freight and express.
268. Postage.
269. Materials and supplies.
270. Equipment.
271. Printing.
272. Blue printing.
273. Miscellaneous.

State Highway Engineer, Assistant Engineers and Division Engineers

(Prefix 94)

281. Salaries.
282. Travel expense (Including auto hire).
284. Automobile operation and upkeep.
285. Materials and supplies.
286. Equipment.
289. Miscellaneous.

STATE EQUIPMENT AND STOCK

(Prefix 72)

Equipment:

51. Salaries and labor cost.
52. Purchase cost of equipment (Including freight and express to initial point).
53. Equipment turned in from jobs.
54. Freight, express, postage, cartage, etc.
55. Materials and parts for repair and renewal.
56. Repair expense in outside shops.
57. Auto licenses.
58. Insurance on equipment and buildings.
59. Shop and store house operating expense (rent, water, light, power, fuel, etc.).
60. Shop and store house equipment (tools, machinery etc.).
61. Shop and store house construction and repair.
62. Credits for rentals charged out to jobs.
63. Credits for equipment charged direct to jobs.

Stock:

71. Purchase cost.
72. Stock turned in from jobs.
75. Credits for stock charged out to jobs.

UNCLASSIFIED DISBURSEMENTS

(Prefix 66)

1. Interest on Highway Bonds.
2. Expense issuing bonds.
3. Workmen's compensation payments.

ENGINEERING

Account Numbers 300 to 399

Reconnaissance Surveys

301. Salaries.
302. Board and lodging.
303. Transportation (Including auto hire).
304. Automobile operation and upkeep.
305. Engineering, supplies and equipment.
309. Miscellaneous (Freight, express, etc.).

Preliminary and Location Surveys

(Including all office and other charges prior to construction.)

311. Salaries (except cooks).
312. Board and lodging.
313. Transportation (Including auto hire).
314. Automobile operation and upkeep.
315. Engineering supplies and equipment.
316. Mess house operation, including cook's salary.
317. Rental of quarters and camp expense not included under mess house operation.
319. Miscellaneous charges (freight, express, postage and other charges which can not be segregated over above items).
321. Drafting plans in Salem Office.

Construction Engineering

341. Salaries.
342. Board and lodging.
343. Transportation (Including auto hire).
344. Automobile operation and upkeep.
345. Engineering supplies and equipment.

346. Rental of quarters and camp expense.
347. Advertisements for bids and cost of furnishing plans.
348. Testing materials.
349. Miscellaneous charges (Freight, express, postage and other charges which can not be segregated over above items).

Bridge Engineering

361. Salaries.
362. Board and lodging.
363. Transportation (Including auto hire).
364. Automobile operation and upkeep.
365. Engineering supplies and equipment.
366. Rental of quarters and camp expense.
368. Testing of materials.
369. Miscellaneous charges (Freight, express and other items which can not be segregated over above items.

Right of Way Descriptions and Negotiations

381. Salaries.
382. Board and lodging.
383. Transportation (Including auto hire).
384. Automobile operation and upkeep.
385. Materials, supplies and equipment.
386. Abstract and ownership description.

389. Miscellaneous charges (freight, express and other charges which can not be segregated over above items).

NOTE—Charge attorney fees, court costs, damages, purchase costs and similar expenses to "Right of Way" under "Construction."

CONSTRUCTION

Account Numbers 420 to 999

Right of Way Costs

421. Purchase of right of way.
422. Damages assessed.
423. Attorney fees and court costs.
424. Fencing or extra work done to secure right of way.
429. Incidental costs not included in above items.

Special Adjustment Items

431. Payments on unit price contracts.
432. Labor, material and equipment furnished by State or County on contract jobs.
433. Labor, material and equipment furnished to contractor and deducted from estimates.
434. Appropriations and payments to counties.
435. Appropriations received from counties.
436. Payments on Forest Road Projects, (Construction costs only).
437. Receipts from County and Government on Post Road Projects.
438. Advertisements for bids.
439. Items out for distribution.

Superintendence and General Expense

451. Salaries of superintendents and timekeepers.
452. General expense of superintendents and timekeepers. (Telephone, postage, office supplies, travel expense, etc.)
453. Operation and upkeep of superintendent's auto.
454. Railway fares which can not be charged to some particular operation.
455. Freight, express and cartage which can not be charged to some particular operation.
456. Miscellaneous construction outfit which can not be charged to some particular operation.
457. Industrial Insurance.
458. Contractors percentage on costs plus jobs.

Clearing and Grubbing

461. Labor, clearing and grubbing.
462. Labor fighting fire.
463. Explosives.
464. Equipment.
469. Miscellaneous.

Excavation and Embankment

(Does not include preparation of subbase for pavement and macadam.)

471. Labor—Grading.
472. Labor—Removal of slides.
473. Labor—Excavation for culverts and culvert ditches.
474. Labor—Side ditches on macadam and paving jobs.
475. Labor—Loading, unloading and handling all general grading equipment.
476. Freight on grading equipment and supplies.

477. Explosives.
478. Blacksmith shop.
479. Equipment.
480. Materials and supplies.
489. Miscellaneous.

Drainage Structures

Spans of 10 Feet or Less

491. Concrete structures (except pipe culvert headwalls).
492. Timber structures.
493. Pipe culverts.
494. Headwalls, catch basins and inlets for pipe culverts.
495. Porous tile drains and other drains.
499. Miscellaneous charges not included above.

Bridges

Spans Over 10 Feet

501. Excavation for foundations.
502. Approach excavation and fill.
503. Labor—Piers and abutments (for wood and steel spans).
504. Materials—Piers and abutments (for wood and steel spans).
505. Freight and hauling—Piers and abutments (for wood and steel spans).
506. Labor—Timber structures.
507. Materials—Timber structures.
508. Freight and hauling—Timber structures.
509. Labor—Steel structures.
510. Materials—Steel structures.
511. Freight and hauling—Steel structures.
512. Labor—Concrete structures.
513. Materials—Concrete structures.
514. Freight and hauling—Concrete structures.
519. Miscellaneous.

Miscellaneous Structures

521. Concrete retaining walls.
522. Rubble masonry walls.
523. Reinforced concrete cribbing.
524. Timber cribbing.
525. Riprap.
526. Guard fence.
527. Concrete gutters.
528. Concrete curbing.
529. Miscellaneous structures.

Special or Unusual Work

541. Removing old structures.
542. Moving buildings.
543. Erecting signposts.
544. Constructing temporary bridges.
545. Diverting irrigation flumes, ditches, pipe lines, etc.
546. Guarding railway, power lines, etc., against damage.
549. Miscellaneous special work.

Maintenance

561. Clearing, grubbing, burning, etc.
562. Removal of slides.
563. Clearing out ditches, culverts, etc.
564. Putting up road signs.
565. Planting trees.
566. Repair and renewal of culverts.
567. Repair and renewal of bridges.
568. Building up and widening subgrade.
569. Dragging, scraping, rolling and reshaping earth roads.
570. Maintenance of rock and gravel surfacing.
571. Maintenance of bituminous pavements and shoulders.
572. Maintenance of concrete pavements and shoulders.
573. General inspection and superintendence.
574. General equipment.
575. General expense which can not be charged to some particular item.

Operating Quarry and Crusher

601. Stripping.
602. Installing and moving equipment.
603. Renewals and repairs.
604. Excavation of rock.
605. Crushing and screening.
606. Equipment.
607. Royalties on rock or lease of site.
608. Construction of bunkers.
609. Construction of road to quarry.
619. Miscellaneous charges not a part of any above.

Operating Gravel or Sand Pit

621. Stripping.
622. Installing and moving equipment.
623. Renewals and repairs.
624. Excavation.
625. Washing and screening.
626. Crushing.
627. Equipment.

628. Royalties on rock or lease of site.
629. Construction of bunkers, loading platforms, etc.
630. Construction of road to pit.
639. Miscellaneous charges not a part of any above.

Placing Broken Stone Macadam or Rock Base.

641. Preparation of subgrade.
642. Purchase of rock, screenings, sand, etc.
643. Freight.
644. Unloading and handling materials.
645. Hauling.
646. Spreading, sprinkling, and rolling.
647. Equipment.
648. Construction of bunkers.
649. Miscellaneous charges not a part of any above.

Placing Gravel Macadam or Gravel Base

661. Preparation of subgrade.
662. Purchase of gravel or sand.
663. Freight.
664. Unloading and handling materials.
665. Hauling.
666. Spreading, sprinkling and rolling.
667. Equipment.
668. Construction of bunkers.
669. Miscellaneous charges not a part of any above.

Cement Concrete Pavement

701. Preparation of subgrade and earth shoulders.
702. Erection, installation and removal of plant.
703. Renewals and repairs.
704. Rentals and depreciation.
705. Cost of aggregate.
706. Cost of cement.
707. Freight.
708. Unloading and handling materials.
709. Hauling materials.
710. Mixing, placing and finishing (including all operating expense).
711. Expansion joints.
712. Rock shoulders.
713. Piping or hauling water.
719. Miscellaneous charges not a part of any above.

Asphaltic Concrete Pavement

721. Preparation of subgrade and earth shoulders.
722. Erection, installation and removal of plant.
723. Renewals and repairs.
724. Rentals and depreciation.
725. Cost of rock for base and shoulders.
726. Freight on rock for base and shoulders.
727. Unloading and handling rock for base and shoulders.
728. Hauling rock for base and shoulders.
729. Placing and rolling rock base.
730. Cost of bitumen.
731. Cost of plant rock.
732. Freight on plant material.
733. Unloading and handling plant material.
734. Operation of plant.
735. Hauling plant material and mixture.
736. Spreading and rolling top.
737. Control testing.
739. Miscellaneous charges not a part of the above.

Camp Construction and Operation

(Includes mess house.)

901. Labor—Construction.
902. Materials and supplies—Construction.
904. Labor—Operation.
905. Materials and supplies—Operation.
906. Rental and repairs.
908. Credits.

Corral Construction and Operation

(Account Numbers 940 to 949)

941. Labor—Construction.
942. Materials and supplies—Construction.
944. Labor—Operation.
945. Materials and supplies—Operation.
946. Rentals and repairs.
948. Credits.

Commissary

(Account Numbers 960 to 969)

961. Cost of operation. (Salaries, office supplies, rental, fuel, etc.)
962. Purchase of goods.
963. Freight, express, hauling, etc.
964. Credits.

INSTRUCTIONS TO LOCATING ENGINEERS

RECONNAISSANCE

RECONNAISSANCE IS NECESSARY:

A reconnaissance is a somewhat hasty examination of the country thru which the proposed highway is to pass, for the purpose of noting its more prominent features and acquiring a general knowledge of its topography with reference to a suitable route. It aims to discover those salient features which instantly stamp one route as distinctly superior to another and so narrow the choice to one or more routes which are of so nearly equal value that a more detailed survey is necessary.

The reconnaissance should be of an area rather than a line, all lines or continuations of lines connecting controlling points being studied as a whole. It should be the effort of the Engineer to first ascertain the the position, character, and limiting effect of the controlling points, natural or otherwise, afterward connecting such points most advantageously, and finally filling in the intermediate details to the best advantage.

No local conditions, such as rocky slopes, swamps, thick underbrush, timber, etc., should be allowed to unduly influence the Engineer as to their real effect upon the total estimate. He should remember that all lines are compared on the basis of completed cost, and finally that it is not the object of location to secure a line of uniform low cost, but of least total cost. It is a common error to reject routes with short sections of heavy construction cost in favor of more uniform, although inferior, routes of greater total cost.

BEST GRADES AND ALIGNMENT FIRST:

The route of best grades and alignment should always be first projected, working back to the final and most economical route; working in the reverse order results in inferior location. The possibility of obtaining a very good line should not preclude the search for a better one. In all cases where possible, the road should be located on southern exposures to secure the benefit of the earlier melting of snow and drying out earlier in the spring.

VALLEY ROUTES:

If the two towns to be connected are in the same valley, it is only necessary to run a line which will have a nearly uniform grade. If there is a large river running

thru the valley, the road will probably remain on one side or the other, but both banks should be examined. In narrow valleys, if the river may be easily bridged, it may be advisable to use the alternate sides to secure lighter grading and better alignment.

CROSS COUNTRY ROUTES:

In cross country routes, where valleys and ridges are to be crossed alternately, involving the necessity of ascending and descending grades, the problem becomes more complex on account of the greater number of possible solutions. Low summits and stream crossings are the controlling points. The intervening country between summit and stream must be examined carefully to determine where the assumed grade will find supporting ground. In such cases, it will frequently be necessary to develop distance. In selecting stream crossings, due regard should be had as to length of structure required, height of banks, character of foundations, force of current, its behavior during freshets, etc.

AVAILABLE DATA:

The Engineer will bring to his aid in the first place the most reliable maps and those drawn on the largest scale. The United States Topographical maps will be found very useful where they exist. State maps, county maps, railroad and irrigation project survey records may often be obtained.

NECESSARY INSTRUMENTS:

In order to reproduce his route, the engineer should use a card compass, together with a barometer and slope level, making complete notes. Frequently, old roads which can be traversed in an auto can be readily mapped by taking the bearings of the courses with the compass, distances from the speedometer, elevations with the barometer and grades with the slope level.

REPORTS:

A proper reconnaissance report contains a graphic impression of the features of the region and route traversed. The alternate routes should be compared, elevations of summits, grades, controlling points, lengths, etc., for each, and approximate estimate of the cost should also be included, and should be accompanied by small scale maps and profiles.

PRELIMINARY LINE

STANDARDS TO BE USED:

The State Highway Engineer will instruct as to the maximum grades, the minimum radius of curvature, standard road bed section to be used, and the monetary value of distance, grade and curvature.

BASE SURVEYS ON U. S. G. S. DATUM:

All surveys should be based on U. S. Geological Survey datum and engineers should have a copy of "Results of Spirit Leveling in Oregon," published by the U. S. Geological Survey, in order to ascertain the location of bench marks in the vicinity of the survey.

BEGINNING AND ENDING:

The beginning and end of all surveys should be tied into section or subdivision corners, in order to enable complete descriptions to be made.

TRACE GRADE LINE:

The preliminary line should be run as close to the desired grade as possible, and for this purpose the grade line should be traced out ahead of the transit party with a slope level and the grade points marked. The best practice is to run the grade line from the summit down. When running on the maximum grade, the slope level should be set 3 to 5 tenths under that grade, in order to provide for a shorter length of line when located with full curves, and compensation on curves of less than 200 feet radius.

TRANSIT WORK:

The distance between angle points may be short if necessary to follow the grade, so the preliminary line should closely approximate the chords in the location curves, which also will keep the located line close to the preliminary.

The transit notes for preliminary lines should be kept as follows, and should read from bottom of page up.

Station	Distance	Deflection		Calculated Course	Magnetic Course
		Left	Right		

DETERMINATION OF TRUE NORTH:

At the beginning of each survey, an observation on the sun or Polaris should be taken to determine the true North and bearings of all courses should be given with reference to the true meridian. For convenience and saving of time

in calculating solar observations with a plain transit, the use of the "meridiograph" is advised. Each day that the sun is visible, a solar observation should be made to check the calculated course. All observations should be made before 10 A. M. and after 2 P. M. to insure accuracy. All these observations and calculations should be recorded in the field notes. The magnetic needle should be adjusted to coincide with the true meridian and the magnetic course read and recorded at each angle point for a check. All angles should be doubled and the result recorded in parenthesis above the single angle. Double center on tangents.

LEVELS:

Always establish a substantial and permanent bench mark at the initial and final points of all surveys and note the datum used. Bench marks should be placed frequently and in no case over two thousand feet apart.

The level note books should be kept as follows:

Station	Back Sight	Height of Instrument	Foresight	Rod	Elevations

Readings should be taken at all points where there are changes in the ground line and all ditches, creeks, etc., noted. The leveler should also record all hub points, for a check on the transit party and watch the stakes for errors in chaining.

The rodman working with the leveler must keep a book in which is recorded the turning points. The elevations should be calculated and compared with those of the leveler and found to be correct before proceeding. Especial care should be exercised to have the back sights and foresights of equal length.

All level notes should be checked by the addition of backsights and foresights and ascertaining the difference of elevation. Levels should be run in one direction and checked in the opposite when convenient. The error should not exceed the value of E in the formula $E=0.1\sqrt{M}$ where E is the error between the two readings and M is the length of the circuit in miles. This should hold good between adjacent benches, also between the origin and any bench.

All bench marks should be plainly marked with the elevation and recorded in the notes with a complete description. Keep the levels up as close to the transit party as possible, so that the engineer may know how the line is running, at any time. Make subtractions in the field and check them later.

CHAINING:

Chainman must use plumb bobs and each time a measurement is made, both chainmen should call their station and the rear chainmen should note that the stake has been marked correctly. Frequently, the chaining can be expedited by chaining on the slope and reading the vertical angle with transit or slope level.

The head chainman should be alert and active. The progress of the party depends to a great deal on his ability to line himself in quickly and keep the axemen on line and the chaining at their heels. He should also be able to pick out suitable places for transit points which will afford as long sight ahead as possible.

STAKES:

Stakes should be substantial and of fair size. One by two inches surfaced on 2 sides and 22 inches long can usually be obtained at local saw mills. When working in timbered regions, usually cedar stakes may be made on the work. For marking stakes, black kiel is preferable to blue as it is much more durable. Mark stakes on alternate preliminary lines, A, B, C, etc., and on located lines L, L_1, L_2, etc.

Stake men should use engineer's figures, making them plain and large. For uniformity, mark stakes as 103+00 or 103+05 and face them toward the transit. At hub points, set guard stakes to the left side and at a uniform distance of 18 inches from the hub. On preliminary lines, use the sign △ to indicate a hub and on located lines. P. C., P. T., P. I., P. O. C., P. O. T., etc., on the back side of the stake. When traversing traveled roads, etc., where it is necessary to offset stakes, face them toward the line and mark on the back as 4L indicating that the stake has been offset 4 feet to the left of the line. Mark the center line with a spike driven through a disc of roofing tin. There is a knack in driving a stake plumb,—acquire it and make the stakes line up.

Hubs should be of good size and long enough to be firm and solid when driven and of durable material. Use cup hub tacks. Use chaining pins when running random lines, property ties, etc.

SAVE OLD BASE WHERE POSSIBLE:

When traversing old roads in well settled communities with improvements already made, it is generally good policy to keep the center line within the fence lines so as to avoid right of way difficulties, except it will be advisable to reduce right angle turns to the standard radius curves, straighten out jogs, or to correct dangerous alignment. The engineer should endeavor also, where it is not necessary to change the grades of the road materially, to lay the center line to fit the old road surfacing as

closely as possible, thereby affecting a saving in surfacing material and taking advantage of a base compacted by years of travel.

DIRECT LOCATIONS:

In making surveys along old roads, or in open country, the location line may be run in direct without the preliminary survey, as the tangents can easily be sighted in and their intersection become the P. I. and the curve which fits in best can be calculated.

OPPOSITION TO LOCATION:

Opposition will often be encountered, particularly when the line crosses improved land. Such opposition as is met should be treated courteously and the rights and duties of an engineering party fully explained. It should be made evident that the utmost possible care is being exercised to do the least possible injury and no man on the party should be permitted to be otherwise than polite and courteous no matter how serious the aggravation. A friend for the Highway Department may be made from an apparently angry opponent.

CROSS SECTIONS:

Cross sections will be taken tranverse to the preliminary lines, and the notes recorded as left or right of the center line. The center elevations should be transferred from the level book and the readings recorded as plus or minus, according as the ground is higher or lower than the center. Distances should be shown under all readings from the center. Where the slopes are uniform, the slope hand level should be used and the angles and slope distances recorded. When working along old roads, take plenty of readings to determine edge of rock surfacing, shoulder, bottom of ditches, etc. Always split angles at transit points and take sections at such intervals and far enough out to secure sufficient data to make a close projection. Keep notes from bottom of page up.

In places where the ground is broken up irregularly, topography may be taken to augment the cross section data. In general, contours should be taken from the cross section sheets and plotted on the map to show the general features.

LOCATE PHYSICAL FEATURES:

Along traveled road, distances should be taken to fences frequently as the alignment will in some cases be governed by the fence lines. Also locate accurately the poles of telegraph, telephone and electric power lines, at points where it may be necessary to move them. Show also the number of wires and name of owners. Locate all physical features necessary to make a complete map and enable any person to fully identify the locality. Locate buildings,

orchards, improved lands, etc., that may have a bearing on right of way claims for damages, or be controlling features in the location. Designate cleared and timbered lands. Note irrigation ditches, show direction on each side of line and grade also.

Intersecting roads should be noted with the direction and distance to nearby towns indicated. Find out the names of all rivers and creeks and names of owners or property abutting on or crossed by the proposed highway. Make estimates on the size of drainage openings required. If same water course is crossed by a railroad or other roads, make a note of opening used. When on existing roads, note if culverts are placed and if sufficient. Take high and low water marks even if approximate at all stream crossings, and note land flooded by back water or overflow. Show character of country traversed as marshy, rock ledges, earth, boulders, etc., and be sure to note everything that will be of value in estimating the cost of the work.

PROJECTION

SMALL ANGLES MAY BE ELIMINATED:

In level or rolling country, a study of the preliminary map will probably show where some of the "kinks" in the line could be straightened out. Small angles are objectionable in that they detract from the appearance of a road. When possible, locate them at summits where they are not so noticeable.

TENTATIVE GRADE LINE FIRST:

To make the projection, first draw in a tentative grade line on the profile of the preliminary line which appears to be well balanced. Then on the preliminary cross-sections which have been platted by the use of a templet set at grade, the section can be balanced and the distance between the center of the section and the preliminary line scaled and spotted on the map. From these points, draw in the location to fit the greatest number.

Where the topography has been platted and when making a projection for a uniform grade between two controlling points, the dividers should be set for the distance between five foot contours corresponding to the rate of grade, thus for 5 percent, 100 feet; 3 percent, 167 feet, etc., and the grade points are located by stepping off these distances on the contours. From these points, fit in the curves and connect with tangents.

THE GRADE LINE:

When crossing irrigation ditches, whose location and grade cannot be changed, it is usually advisable to cross over without syphoning, even though it makes a hump in the grade line. Inverted syphons are expensive and usually a source of trouble to all concerned, and their use is to be avoided where possible.

Stretches of slack grade for short distances look bad on long tangents. Take it up on curves if possible. To avoid badly broken grades in undulating country, the minimum distance between points where the grades are reversing should be from 300 to 500 feet, depending upon the uniformity of grades on the road under consideration.

In general summits should be in cut and sags in fill. Avoid short vertical curves. The longer they are made the longer the sight distance over summits and the better they look on the ground. Plenty of long vertical curves are a scenic asset to any road. The minimum grade for side hill roads taking drainage from above should be 1 percent. In case it is necessary to use flat or even level grades for short distances, make the grade of the ditches sufficient to lead the drainage to frequently spaced culverts. Or in cuts, place cut ditches above the slope also. On roads made from side borrow, etc., there is no objection to level grades with sufficient crown.

BALANCING QUANTITIES:

In balancing, allow from 15 to 25 percent excess of excavation over embankment quantities in earthy materials the greater percentage in lighter work. Swell in solid rock should be estimated between 10 and 30 percent. It should be remembered that a portion will be lost in blasting on side hill slopes. In heavy timbered country, a very appreciable amount of material will be required to fill the holes left by the stumps; however, local conditions of soil will govern the amount of shrinkage to provide and a close study should be made of this feature.

In general, quantities should balance, but there are many exceptions. Excess excavation will occur on steep side hills where embankment slopes will not catch and it is necessary to bench out the entire road bed width, railroad undercrossings, etc. Embankment will exceed across low marshy places where it is necessary to keep the grade line high, approaches to overhead railroad crossings, and to bridges across rivers, etc.

HAUL:

To compute the over haul and show the disposition of material, the mass diagram should be used. Standard form diagram will be furnished. The haul limits of cuts should be shown on the profile. When possible, arrange the haul down hill. A short haul up hill near the end of a cut is not objectionable, however.

SLOPES:

The slopes in excavation will be in general, 1 to 1 in earth, ½ to 1 in cemented material, ¼ to 1 in solid rock. All embankments will be to 1 to 1½ slope.

ROADBED SECTIONS:

Roadbed section standards will be fixed for each job, and will not be changed except by permission from the State Highway Engineer for special cases of peculiar topographical conditions.

SIGHT DISTANCE:

Engineers should bear in mind the necessity of making the sight distance as long as possible. This may frequently be obtained by widening on the inside of curves.

USE EVEN FIGURES:

Grades should be established in tenths preferably and grade points also should be in even tenths.

VERTICAL CURVES:

Vertical curves should be placed at all grade intersections where the difference in grade is greater than five-tenths. It will not be necessary to calculate vertical curves. Use circular curves fitted to the ground line in the same manner as they are adjusted to the contour of the ground on the map. The elevations at stations may be scaled and the elevations noted, so that the same elevation may be used at all times. The degrees of curves used should be marked in small figures, so that the draftsman in tracing can pick out the right curve at once. Show the beginning and end of each vertical curve.

HORIZONTAL CURVES:

With the same central angle, use long flat curves in preference to sharp ones. The minimum radius is 200 feet or a curve of 28 degrees on outside curves and 57 degrees for inside curves, except that on extremely heavy construction, this may be modified, but should be approved by the State Highway Engineer. The best practice requires grade compensation on all curves greater than 28 degrees.

QUANTITIES:

The profile of the projected location should be platted and carefully studied as to the effect of shifting alignment or grade line in order to secure more economical construction. The quantities should be taken off either by planimetering the platted cross section, or by the use of graphic slope tables, and such changes made to effect a balance as are necessary.

LOCATION

STAKING:

The projected line may be computed and the courses run in directly or, in open country, it may be easier to scale off the distances on the map and locate the P. I.s or other points on the ground, connecting up with the tangents as projected. With either method, ties should be taken at frequent intervals in order to be certain that the located line bears the same relation to the preliminary that the projected one does. An opportunity to check the bearings or the courses is afforded when tying in.

Arrange location transit notes as below:

Station	Deflection		Curve Data	Calculated Course
	Left	Right		

Curves should be calculated on the basis of Radius equal 5730 feet for a 1 degree curve. Useful tables to shorten calculations will be found in Harger & Bonney's "Highway Engineering." The arc that subtends the central angle is the length of the curve; therefore, for curves from 8 degrees to 16 degrees, use 50 foot chords; to 32 degrees, 25 foot chords; to 56 degrees, 10 foot chords. Keep the location stationing continuous and avoid equations where possible.

STREAM CROSSINGS:

Careful study of all river or major stream crossings should be made. The grade line should be not less than 4 feet above extreme high water. A vicinity map on a large scale should be made, showing topography, course of channel, profile on center line of bridge and 10 feet on each side, high and low water marks, test pits for foundation, etc., in fact, all data necessary for the Bridge Department to design a suitable structure.

TEST PITS:

Test pits should be dug at points where classification is in doubt, both to form the basis of a close estimate and also to give intending contractors a chance to judge the job.

DRAINAGE:

Remember that drainage is the whole thing in highway work. The size of culverts will be determined after a careful study of the drainage area, slope and rainfall

conditions. Tables covering these factors are given in reference books. The length may be estimated from the cross sections and should extend at least two feet beyond the slope stakes on high fills. Where head walls are used, the length may be shortened.

SAMPLES OF MATERIALS:

Get samples of stone or gravel along the route of the proposed highway which you judge to be suitable for surfacing purposes, and send them in for tests. Distance from quarries, railroad or transportation facilities, water, etc., should be recorded.

RAILROAD GRADE CROSSINGS:

Railroad grade crossings should also receive special study. Plan to eliminate existing grade crossings, if feasible, and on new work, make underground or overhead crossings on main trunk line railroads controlling points if necessary. Frequently, two railroad crossings close together may be eliminated by continuing the highway on the same side of the track. In any case, for railroad crossings, a map should be prepared showing the highway and the railroad for a distance of 1,000 feet in each direction, and also profile of same.

BENCH MARKS:

Set all bench marks near grade and at the edge of the right of way or in places where they will not be disturbed in grading or clearing. They should be plainly marked with the elevation and recorded in the notes with a complete description. When trees are used, it is a good plan to mark a stake and nail it to the tree rather than to cut away the bark.

CROSS SECTIONS:

Cross sections should be taken at each break in the ground with a hand instrument, taking either level readings or slopes, as may be most convenient. They should be taken somewhat beyond where it is expected the slopes will catch in order to allow for minor changes in grade or alignment.

REFERENCE POINTS:

As final step in completing the location, the P. I.s or important P. O. T.s should be referenced out by angle and distances to two sets of points, preferably at about ninety degrees with each other.

RECORDS TO BE COMPLETE:

All maps, profiles, estimates and general records to be completed while the surveys are in progress, thus avoiding an accumulation of work at the end of the survey.

RIGHT OF WAY:

The right of way will be in general, sixty feet in width. In event that it is necessary to obtain a greater width on account of slopes, etc., note should be made of this fact on the maps.

To the located line should be tied all property, subdivision and township lines which the road crosses. For this purpose, a random angle line may be run from the line to each corner of the subdivision crossed. The location of the corners will be computed by coordinates and located on the maps. Mark all corners found in the field as "found, iron pipe," etc. The County records should be examined to determine ownership. Property lines, where well defined, should be designated by station and angle at intersection with center line and distance to each corner. See form of description to be used under "Instructions to Locating Engineers relative to preparation of Maps, Profiles and other records."

FIELD BOOKS:

The date should be entered in the field book at the beginning of each day's work, with the initials of the men in the party and a note on the weather should also be entered in the field book, **in the field, each day and not left until later.**

No notes of any kind should ever be erased or destroyed. If the line is backed up and part of it abandoned, the notes should simply be crossed out by drawing two diagonal lines across the page and writing "Abandoned" across it in such manner that the notes will still be legible. Care must be taken on all work that the notes are clear, accurate and neat. Slovenly notes are a sure indication of slovenly work and it takes time and costs money to hunt up or decipher notes that are not properly taken or not properly indexed.

REPORTS

WEEKLY REPORTS:

All engineers in charge of surveys shall submit Weekly Reports on Form No. 39. These reports should be mailed to the General Office not later than Monday morning, and should give in concise form, a summary of the progress of the work during the previous week.

The principal information to be furnished by these reports is relative to camp locations, mail and telephone addresses, etc., but there is also much valuable information

to be included relative to the work under way, the attitude of the County officials and of the local people, the advantages of alternate routes, explanation of delays, weather conditions, etc. What is desired is general information such as an engineer making a personal inspection of the work would expect to have given him.

EQUIPMENT INVENTORIES:

Engineers on location work will submit at the end of each month a complete inventory of all equipment on hand.

FINAL RECORDS

RECORDS TO BE SUBMITTED:

Upon the completion of a location survey, it shall be the duty of the Locating Engineer to submit to the office to which he is reporting, the following records of his survey.

1. Maps of all lines run.
2. Profiles.
3. Cross-sections.
4. Estimates of quantities and cost.
5. Detailed Report.
6. Right-of-way descriptions.
7. Field Books.

MAPS:

Maps shall be prepared on Buff colored, duplex detail paper, width twenty-one inches, scale 100 feet to the inch.

Platting shall be by co-ordinates, and the latitude and departure notes computed upon standard forms for that purpose, turned in with the other records.

Maps shall show all preliminary lines with station numbers of angle points and bearings of courses; all section lines, quarter-section lines, and other subdivision and property lines; all existing roads, trails, railroads, canals, irrigation ditches, and telephone and power lines; all fences, houses, barns, orchards, gardens, cultivated fields, pastures and other improvements adjacent to the line; the located or projected line with the stationing of points of curve and points of tangent, degrees of curves, central angles of curves, bearings of tangents, equations, and mile-posts; all creeks, rivers, lakes and springs; all other physical features natural or otherwise, that have any bearing upon the location and construction of the road, or that serve as means of identification of localities thru which the line runs.

In all rough or rolling country, or other sections where the natural topography is a controlling feature in the location, contour topography should be shown on the detail map. The contour interval should ordinarily be five feet, and the contours should be shown on the map in Burnt Sienna water color, every fifth contour being shown slightly heavier than the others.

All features shall be shown in accordance with the standard conventions as shown upon sample maps. The preliminary line, its station numbers and bearings should be shown in red, all water features in blue, and the located line and all property lines, artificial features, and other information in black. Contour elevations should be in the same color as the contours.

Maps should be so platted that, in general, the top or the left end is north, that is: a survey running in a southerly or easterly direction should be platted from left to right, and a survey running in a northerly or westerly direction should be platted from right to left.

On surveys of considerable extent it will often be desirable to submit a map on a smaller scale, to bring out extended features and to show location with reference to towns, railways, rivers, etc. Such maps can often times be prepared with a very small amount of additional work.

All maps should bear a simple title giving the name of highway, name of county, name of section, date of surveys, date of approval, place for approval by the State Highway Engineer, and name of locating engineer, and should state whether the centerline is staked in the field or only projected.

PROFILES:

Profiles shall be platted on hard finished cross-section paper, 10x10 to the inch, and eleven inches in width (10 inches engraved), and a tracing of same submitted on orange profile tracing paper.

The scale shall be 100 feet to the inch horizontally and 10 feet to the inch vertically.

Profiles shall show the ground-line, the grade-line, the stationing of all points of curve, points of tangent, etc., the degrees of curves, the central angles of curves, the bearings of tangents, equations, bench-mark descriptions, reference points, mile-posts, percent of grades, elevations and pluses of grade intersection points, lengths of vertical curves, stream names, names of towns and villages, elevations and pluses of existing road and railroad crossings, pluses, sizes and lengths of existing culverts, bridges, etc., pluses, sizes, and lengths of all proposed structures, quantities in each individual cut and fill, with the classification of materials, and locations, depths and findings of all test pits.

The title should show the name of county, name of highway, name of section, datum of elevations, width of

roadbed used, side slopes in cuts and fills, date of surveys, and date of approval of profile.

At the end of the profile should appear a complete summary by miles, of the estimated quantities for the entire section covered by the profile.

The profile should be plotted from left to right or from right to left as corresponds with the plotting of the map.

The grade line should be laid and balanced for a level roadbed section of the width specified for the particular survey in hand.

The distribution of all quantities must be shown in the manner indicated on the standard profile. It is not necessary that points of haul divide and distribution limits be accurately figured, the object of the distribution diagram being to show how the total excavated yardage is to be used, making it possible to check up the balance of quantities, the allowances for shrinkage and swell, and the amounts of waste and borrow.

On profile tracings prepared in the field the grade line and all information pertaining thereto, and all quantities, classification and quantity summaries, should be shown only in soft pencil and not inked in, as should also any approximate information which is of value to this Department but which it might not be advisable to turn over to bidders.

On extended surveys it will often be desirable to have submitted small scale or condensed profiles showing distances, controlling elevations, towns, river crossings, etc.

TRACINGS:

Unless special instructions are issued, no tracings will be made up in the field. It is found that draftsmen differ so greatly in their methods of showing different features, that a great amount of erasing and changing is required to be done on tracings made up in the field, to make them comply with our own and the standards of the Bureau of Public Roads. To avoid this, and to secure greater uniformity in our records, tracings will be prepared in the General Office from the detail maps and profiles made up in the field.

CROSS-SECTIONS:

Cross-sections shall be plotted on standard cross-section sheets 22 inches by 36 inches, outside dimensions.

The scale may be either five feet to the inch or ten feet to the inch. The sections shall in all cases be plotted by elevations, and the elevation at center-line noted on the section.

Cross-sections should be at intervals not to exceed 50 feet, except in the most uniformly sloping country. If the sections are taken in the field from the preliminary line, and adapted to the located line by offsets, great care must be taken that the sections given are so located with

reference to the location line as to give fairly correct quantities. In many instances where the located line is some distance from the preliminary, sections interpolated from sketched topography, and inserted between the actual preliminary sections will give much closer estimates of quantities than can be secured from the preliminary sections alone.

ESTIMATES:

For all reconnaissance, preliminary, and location surveys, estimates of quantities and costs shall be made in as great detail as is consistent with the nature of the survey. On preliminary and location work the quantity estimate should be made up by miles and the mile summaries and total summaries shown on the profiles and in the detailed report. The cost estimates should appear only in the report.

The following list of items may be used as a guide to avoid the ommission of important features:

Items	Units
Clearing	Acres
Grubbing	Sq. Rds.
Common Excavation	Cu. Yd.
Intermediate Excavation	Cu. Yd.
Solid Rock "	Cu. Yd.
Overhaul, per 100 feet	Cu. Yd.
Culvert Pipe (Small sizes first)	Lin. Ft.
Porous Drain Tile	Lin. Ft.
Underdrains	Lin. Ft.
Concrete, Classes A, B, and C	Cu. Yd.
Rubble Masonry	Cu. Yd.
Guard Fence	Lin. Ft.
Rip Rap	Cu. Yd.
Cribbing	Lin. Ft.
Fir Piles	Lin. Ft.
Lumber and Timber	M. F. B. M.
Structural Steel and Iron	Lbs.
Metal Reinforcement	Lbs.
Catch Basins	Each
Inlets	Each
Broken Stone or Gravel	Cu. Yd.
Trestle	Lin. Ft.
Bridges and other structures	Each
Force account items	Dollars

All estimates should state clearly the basis upon which they are made, viz: width and type of roadbed, side slopes in cut and fill, maximum gradient, minimum curve, radius, whether quantities are based on preliminary or location cross-sections or on slope estimates, etc.

DETAILED REPORT:

The detailed report should contain all information in connection with the survey that cannot be shown upon the

maps and other records submitted, and in addition should contain a general summary of the important features shown in detail on such maps and other records.

It should state the purpose of the survey: describe its limits and the locality traversed; outline the methods of survey and the various considerations entering into the selection of route and the adoption of particular types of construction; describe other possible routes, contain suggestions as to procedure necessary to prepare work for construction; give such information in regard to attitude of property owners and citizens as has been obtained locally or otherwise; describe all possibilities of future trouble in securing rights-of-way, crossings with railroads, navigable streams, etc. It should contain a tabulation of the costs of the survey showing the costs of different items involved and giving the per mile costs of field and office work. It should also give a summary of such important features as length of line, type of roadbed, maximum gradients, minimum curve radius, estimate cost of construction (total and per mile) and any recommendations deemed necessary.

RIGHT-OF-WAY DESCRIPTIONS:

Complete right-of-way descriptions shall be prepared and submitted with other records of the survey.

The right-of-way will, in general, be 60 feet in width and the description should be worded as follows:

J. J. Jones:

All that part of the property of J. J. Jones in the NW. ¼ of Section 22, T. 2 S., R. 6 W. W. M. included within a strip of land sixty feet wide being thirty feet on each side of the center line of the Pacific Highway as surveyed over and across said property and as more particularly described as follows:

Beginning at a point in the center line of the existing county road, which point is approximately 235 feet North and 465 feet East from the quarter corner between Sections 21 and 22, T. 2 S., R. 6 W. W. M. running thence N. 60° 18′ E. a distance of 299.6 feet; thence on a 318.4 ft. radius curve to the left, a distance of 100.0 ft; thence N. 42° 18′ E. a distance of 981.2 feet; thence on a 573.1 feet radius curve to the left, a distance of 402.0 feet; thence N. 2° 06′ E. a distance of 891.6 feet to a point on the North boundary of the Walter L. Fish D. L. C. No. 59, which point is approximately 203 feet South and 192.1 ft. East on the section corner common to section 15, 16, 21 and 22, T. 2 S., R. 6 W. W. M; said parcel of land containing 2.35 acres more or less

It will be noted that the above type of description may start and end at any convenient points, whether these points are on the property lines or not, and that it covers absolutely all of the grantor's property within the sixty foot right-of-way provided a sufficiently long section of

center line is described. It is a blanket description which has all the advantages of a metes and bound description, but does not require as great accuracy in the location of property lines.

Descriptions should be arranged consecutively from one end of the line to the other, bound together, and marked with the name of county, highway, section, etc.

FIELD BOOKS:

Before being turned in, all field books should be completely indexed and should bear the names of the county, highway, section, kind of notes, and name of the engineer in charge.

INSTRUCTIONS TO RESIDENT ENGINEERS.

GRADING WORK

GENERAL

PLANS, SPECIFICATIONS, ETC.:

The Resident Engineer should see to it that he is furnished with all the field notes, maps, profiles, specifications, structural plans, etc., pertaining to the work to be done. He should study carefully all of the information contained therein, and should familiarize himself with all of the details of the specifications, inquiring particularly of the General Office or the Division Engineers as to whether he has been supplied with copies of all special provisions, supplementary specifications, unit prices, etc.

CONDUCT OF WORK:

Resident Engineers, in their dealings with the contractors, are expected to follow a courteous, businesslike and ethical course, and to remember that it is the contractor's business to make a fair profit on his work. Resident Engineers are not on the job to prevent this, but to see that contractors perform their work in strict accord with the specifications.

Any Engineer assigned to special duties on any residency must be given every assistance by the Resident Engineer. Any friction between employes is prejudicial to the State's best interests.

The Resident Engineer should be firm but courteous and reasonable in all his dealings with the people living along the road. The people will often be unreasonable, but the engineer must remember that the man who loses his temper loses his case. The traveling public is due full consideration in all matters affecting their convenience during the construction of roads and bridges. Engineers are urged to exert every ingenuity at their command to make this inconvenience of as light a nature as possible.

The Resident Engineer should go over the work under construction frequently and give such directions as may be necessary. He should attend to any reasonable request of the contractors, furnish them grade and line stakes when necessary, and in general do all things requisite to enable contractors to work to advantage and without delay.

FINANCIAL END OF JOB:

For each construction job a definite sum is set aside for the completion of that job. This amount is usually the amount of the preliminary estimate or the contract price, plus ten percent for engineering and contingencies. The Resident Engineer will be held responsible if the expenditures on the job exceed the amount set aside. For that reason, he must watch his estimates and keep a record of the expendiutres on the job with the end in view of determining at the earliest possible date, whether or not he will be able to complete the job with the amount of money available, and of avoiding the possibility of exceeding this amount before any additional funds that may be required have been provided. In many instances, it is impossible to provide additional funds to complete a job. In that case, the work must be shut down before completion, and it is a very serious matter if the Resident Engineer allows the amount appropriated to be exceeded before he closes down the work.

The General Office undertakes to avoid over running of appropriations, but the actual work is always far ahead of the estimates and bills and it is impossible to know how much the Resident Engineer is holding back for finishing, etc., and how near the work is to completion. For that reason, the Resident Engineer must give close attention to the financial end of his job.

SANITATION:

It is part of the general policy of this department to cooperate with the State Board of Health, and give especial attention to the sanitary conditions of the camps of contractors as well as on State work. It will be proper for engineers to recommend to contractors such precautions as will insure a healthy camp and to cooperate with the local physicians to the end that the sanitary conditions of all camps be regularly inspected.

FIRST WORK TO BE DONE:

On assignment to a residency, Resident Engineer should immediately examine the located line, trace out portions that have been lost and reference in points which will be needed after construction. Bench marks should be set near the edge of the right of way where they will not be disturbed during construction and close to the grade elevation. Detail plans for small timber bridges should be drawn up in standard form and the bills of material required prepared. Sizes of culverts and lengths should be checked up, and, if in doubt, the drainage area should be computed roughly. A complete list of culverts should be ordered early so the work will not be delayed. The right of way should be staked for moving back encroaching fences and for the clearing.

REVISIONS:

If the discrepancies are found in the location, the Resident Engineer must check over to be sure that the error is not his own. The final location stationing is to be maintained throughout. In case of error in one station, maintain the stationing by recording the station long or short, as the case may be, giving its correct length.

While the clearing is going on, those portions of the line that are cleared may be cross-sectioned for construction. A close study of the ground should be made and frequently economical changes in grade or alignment will be desirable. Resident Engineers should notify their superiors of proposed revisions, making a comparison of both lines.

CROSS-SECTIONING:

Cross-sections must be taken at all breaks in the ground surface and on curves with sufficient frequency to retain the curve alignment, and when passing from cut to fill, obtaining a cross-section for each grade point as such occur on the left or right. Ends of embankment at bridge openings should be staked as a wedge and two one-quarter cones.

For cross-sectioning purposes, the roadbed will be considered a level section and the grade that shown on the profile, except where indicated on the roadbed section adopted for that particular project. The ditch will be taken out during construction. The crown will be shaped up with a grading machine in the subsequent finishing. Exception is made to this method when constructing roadbed across flat country by the method of side borrow. In this case, the section will be staked for a crowned roadbed.

WIDEN INSIDE OF SHARP CURVES:

On curves approaching the maximum degree of curvature, the inside will be widened. Sharp curves will be superelevated. Those conditions should be provided for in cross-sectioning.

SLOPE STAKES:

Cross-sectioning slope stakes will be marked with the cut or fill and the distance out on one side thus $\frac{C2.6}{14.6}$ and the station and plus on the rear.

QUANTITIES:

The quantities should be calculated at once and the totals placed on the profile to see if a check is made with the projection and a balance obtained before contractor begins on the work.

CONDEMNATION SUITS:

In case right of way condemnation suits are delayed until construction is started, Resident Engineers will notify contractors not to enter property until permission is given by the State Highway Engineer.

CLEARING AND GRUBBING:

Clearing should be thoroughly done. The specification regarding burning all brush and timber must be fully enforced to the end that all debris should be removed entirely from the right of way. Clearing must not be piled within the reach of high water where it can be floated back on the right of way into the drainage openings. Dead and leaning trees outside of the right of way should be removed under special arrangement, all grubs, roots, etc., to be burned up the same as clearing.

The Resident Engineer should work in harmony with State and Government Forestry officials, particularly with reference to burning right of way clearing during the prohibited season without permit.

CULVERTS:

All culverts should be staked preferably at right angles to the center line to shorten the length but when this cannot be done on account of topographical conditions, the head walls should be parallel to the center line in all cases.

All culverts should be placed in trenches and on solid foundation. The minimum depth of trench should be at least equal to the lower one-half of the pipe. If it is impractical to place a portion of the culvert in excavation, then the embankment underneath should be built of rock to insure against settlement. The trench should be excavated to the shape of the pipe and the pipe should be laid with a camber in the center. Pipe laid on a straight grade will invariably show a sag in the center after the fill is placed. All back filling should be thoroughly tamped. Cover all pipes where material is to be dumped upon or against them, so that there will be no chance of breakage from rolling rocks or shifting from pressure. A thorough inspection must be made of all culvert work to see that all the joints are tight, laid to stakes, etc. In building concrete box culverts, see that the concrete is in correct proportions, that all the reinforcing steel is in place and that the embankment is not placed over it for a minimum of two weeks, and then the inside forms should be left as long as possible. Remember that the greatest load it will have to carry is before the embankment is settled.

In localities where timber box culverts may be used as temporary construction, the opening should be made at least eighteen inches greater than the inside diameter of the pipe estimated to be necessary.

Over all culverts, the minimum covering should be one foot.

DITCHES:

Surface ditches above the slope stakes of cuts are to be of ample size and all excavated material placed on the lower side in a continuous uniform bank forming a levee,

adding to the value of the ditch. Ditches must be led away at the ends of cuts to prevent water running against the embankments.

Culvert ditches must be of sufficient size and on a grade to be self cleaning. On side hill work, before fills are made, the ground should be examined for hidden springs which may break out during the wet season. If any are suspected, blind stone drains should be constructed.

During severe storms, Resident Engineers should go over their line, closely observing the quantity and action of the storm water run off with a view of determining more definitely the sufficiency of openings or ditches, or the need of larger ones than contemplated, or the advisability of reducing others.

RETAINING WALLS:

Retaining walls, where required, will be built of rubble masonry, laid up in cement mortar. The outside batter will be one inch in twelve inches and the base one-half the height. The top should be eighteen inches wide and the guard rail posts should be set in as the wall is built. Small toe walls or small retaining walls may be laid dry in some locations. In other locations, the half viaduct type of bridge may be found more economical than walls. Timber cribbing should not be used except in special cases. Its life is short except when cedar logs may be obtained.

Low parapet walls, log railing or guard fence should be placed on all walls, dangerous curves, etc. Standard designs should be followed.

SHRINKAGE:

Resident Engineers will make a study of the amount of shrinkage that will be required on the various embankments which is governed by the various kinds of material. In general, the amount of shrinkage will be a percentage of the height and the contractor should be informed of the amount before he completes roughing in the embankment. Always allow plenty and bring up embankment to full width at the added height. When embankments are in sags, especially, no harm is done if the estimated settlement does not occur.

BORROW AND WASTE:

Surplus material should be used to widen the embankments uniformly in all cases and not wasted unless for some good reason and particularly not wasted above the slope stakes in excavation. It is to be understood that all excavation is to be hauled the distance required and contractors should not be allowed to waste and borrow at their own expense except in exceptional cases. Unsightly waste banks and borrow pits are not to be tolerated. If necessary to borrow, widen out adjacent cuts. Exception is made in flat, poorly drained regions where side borrowing is recommended.

Borrow pits should be staked out for contractors and the notes recorded. The excavation should be made regularly so the cubic contents can be measured and left in a neat and clean condition with slopes as shown on the standard roadbed section and should drain their entire length. Centers and grades should be given through the cuts as the work progresses to insure the contractors excavating them to requiring slope. Before acceptance, the width between slope stakes should be checked up.

CLASSIFICATION:

All out-croppings of solid rock on the surface should be noted in the cross-sections, large boulders should be measured and recorder as they lay on the natural ground. As the work progresses, the platted cross-section sheets should be taken into the field and the classification recorded.

In cuts where the classification is mixed, elevations should be taken on the strata as shown on the slope and platted on the sheets. Engineers should note depth of drill holes before hard material is reached, examine coyote holes before blasting, and observe how material breaks up, how it is handled, the cost of moving, etc., in short, everything that may be of value in arriving at a fair classification. Engineers should talk the classification over with the contractor and in event of disagreement, refer the matter to the State Highway Engineer.

OVERBREAK:

The matter of overbreak must be watched carefully to see that shots are not placed behind the slope lines or holes loaded excessively heavy. The use of photography to show methods of work, equipment, progress, classification, etc., is encouraged.

OVERHAUL:

The free haul limit on all excavated materials is three hundred feet. All material hauled a greater distance must be measured and the excess haul paid for as overhaul. The mass diagram method of overhaul computation should be used as far as practicable. The standard form of mass diagram will be furnished upon request.

FINISHING:

Finishing stakes should be set and the contractor must work to these stakes, the engineer noting that the embankment slopes are not hollow nor cut slopes bulging; also that the roadbed is not sagged or raised between stations, and that the whole is finished up in workmanlike manner.

SURVEYS FOR BRIDGES AND SPECIAL STRUCTURES:

For each structure requiring a special design, the Resident Engineer should submit to the General Office a vicinity

map prepared upon the standard form for that purpose, and in accordance with the sample map which will be sent upon request.

These maps should be made up on as large a scale as can conveniently be shown upon the standard sheet, a scale of ten feet to the inch being satisfactory for small structures. Ordinarily, the topography contour interval should be two feet.

WATCH FOR SURFACING MATERIAL:

The Resident Engineer should familiarize himself with the possibilities of the country adjoining his residency, particularly as to the location and character of surfacing material.

PAVING WORK

GENERAL

CONDUCT OF WORK:

Study your specifications until you are entirely familiar with them and always refer to them when in doubt. Be on the job when the work starts in the morning and stay until the last load is laid in the evening.

Keep a careful record of the number of loads of material delivered, samples taken and tests made. Also record all peculiarities of subgrade, giving the stationing, and if along one side of the road, this should be mentioned. Make your reports out daily and send them in promptly, or hand to the Resident Engineer.

Don't give orders to the men. Go direct to the foreman. Don't take anything for granted—check everything. Most contractors are trying to do the right thing and do not resent constructive inquiry or criticism and those who are opposed to careful inspection need watching all the more. Don't get familiar with the contractor, accept cigars, fishing trips, and small favors or you may lose your job. Don't quarrel with the contractor. Be firm and if he refuses to be reasonable, take the matter up with your superior and he will do the quarreling.

Don't forget that you are working for the State of Oregon and are endeavoring to get full value out of every dollar expended and that a good finished product is ample repayment for all the care and energy expended in procuring good results. Your ability is judged by your finished product.

DUTIES DEFINED:

It shall be the duty of all Resident Engineers and paving inspectors to thoroughly familiarize themselves with the specifications covering the work in hand and to keep a copy of same in the field while the work is in progress. These specifications are a part of the contract and must be adhered to in all cases. This is particularly true on paving work where the durability of the pavement may be impaired by a deviation from the specifications in any particular.

The inspector shall have the authority to enforce the specifications, and in case of disputes between the contractor and inspector, the matter should be referred to the Resident Engineer in charge of the work. The inspector will work under, and report direct to the Resident Engineer.

As set forth in the specifications, notice should always be given the contractor in writing, when the terms of the specifications are being infringed. Only in urgent cases should this be done without consulting the Division Engineer.

SHOULDERS:

See that shoulders are built full width and true to the cross section as shown in the plans and specifications. This may not appear to be an important item, but an otherwise perfect job is often spoiled by slovenly work on the shoulders.

GRADE STAKES:

Where preliminary grading is to be done on paving jobs, the slope stakes should be set in the ordinary manner and when the grading is completed, hubs should be driven on a 3 or 4 foot offset from the edge of the pavement. These hubs should be driven flush with the ground and both line and grade given on same. The station, offset from the center line, and cut or fill for the edge of the pavement should be plainly marked on the guard stake and recorded accordingly.

On light work along old roads, involving cuts or fills of only a few inches, it is not necessary to set slope stakes for the grading as the offset hubs can be set at the edge of the shoulder and can be used for both grading and paving, and grading quantities can be paid for on the final cross sections. For this class of work, the guard stakes are moved back to a safe distance and the distance to the hub noted thereon. Grades should be given at 50 foot intervals on tangents and at each chord length on curves, to the nearest .05.

Cross section the work very carefully on the located line as this is the basis of all estimates and final settlement. Bear in mind that every job is an embryo law suit and keep your records accordingly.

A convenient method for establishing your center line along an old road is to drive a nail through a small piece

of red flannel or a tin roofing washer and set an offset stake at the edge of the road. This will facilitate the setting of offset hubs, and taking cross sections to a marked degree.

SUPERELEVATION OF CURVES

AMOUNT OF SUPERELEVATION:

As a means of promoting safety, it is advisable to both superelevate and widen pavements on curves. Theoretically, the amount of superelevation depends on both the radius of the curve and the speed of the traffic. However, since all traffic regulations require that traffic slow down on approaching sharp curves because of the limited sight distance which makes it unsafe, speed then may be considered a constant and the variable the radius of the curve used. The following amounts of super-elevation are recommended for a sixteen foot roadbed.

Degree of Curve	Super-elevation	Run Off
Less than 4 Degree	None	
Less than 4 Degree	0.4	70
Less than 8 Degree	0.5	80
Less than 12 Degree	0.6	90
Less than 16 Degree	0.7	100
Less than 20 Degree	0.8	120
Less than 24 Degree	1.0	150
Less than 36 Degree	1.2	150
Less than 40 Degree and above	1.4	150

Pavements which are of sufficient width on tangents to carry traffic become too narrow to accommodate the same traffic on curves even though traveling at moderate rates of speed, since drivers all have a tendency to cut to the inside to take advantage of the crown of the inside one-half of the pavement. It is advisable then to extend the slope of this crown the full width of the curved pavement in the form of superelevation which, together with added width on the inside, will tend to distribute traffic over the entire roadway and add to the comfort and safety of the travelling public.

CURVES BETWEEN LONG TANGENTS:

Standard superelevation should be reached at the P. C. of the curve and continued uniformly to the P. T. the run off being carried entirely on the tangents.

The inside of the curve should be left at the same elevation as it would be on tangent, the superelevation being obtained by raising the outside.

The standard crowned roadbed section should be tapered gradually onto the run-off to a crown of about one inch,

which should be carried all the way around the curve. A perfectly flat crown will look concave when constructed.

CURVES IN THE SAME DIRECTION WITH A TANGENT BETWEEN:

Where the length of a tangent between curves is not greater than the total run-off of both curves the superelevation should be carried over the entire tangent, giving only such run-off as is required to change the superelevation of one curve to meet that of the other.

COMPOUND CURVES:

Let what run-off is required extend into each curve. Ordinarily, the run-off would not extend more than fifty feet into each.

REVERSE CURVES:

In reverse curves, the run-off for each curve must be made entirely within the curve and for that reason it is usually best to lower the inside of the curve in addition to raising the outside. The required superelevation should ordinarily be reached within about fifty feet of the P. R. C. The pavement section should be level at the point of reverse. The cambered crown should be carried on both curves.

In lowering the inside of curves where the grade is less than three percent, care must be taken to prevent the formation of pockets which will not drain.

CURVES IN OPPOSITE DIRECTION WITH SHORT TANGENT BETWEEN:

Where the tangent is too short to carry the full run-off, the run-off may be extended into the curve a short distance and if necessary, shortened somewhat.

Unless the tangent is 250 feet or more in length, the pavement section should not be returned to its normal crown.

WIDENING OF PAVEMENT ON CURVES:

Subgrade should be built up in excess of the tabular superelevation to allow for rolling.

Curves sharper than 12 degrees should be widened as follows:

Degree of Curve	Extra Width at Center of Curve
12° to 16	2.0′
16 to 30	3.0′
30 and above	4.0′

The extra width should all be added to the inside of the curve, and should taper gradually from the width at the center to zero at points twenty-five or fifty feet outside of the curve.

SUBGRADE:

The first essential feature of any pavement and one upon which too much stress cannot be laid is the subgrade. This should conform to the specifications in every detail as it is impossible to build a satisfactory pavement on a soft or uneven foundation. No excuses such as lack of equipment, labor, etc., should be tolerated as this is merely a ruse to slight the work in hand. It should always be kept in mind that the contractor bid on the specifications as set forth and the contract was awarded accordingly.

ROCK BASE:

Where crushed rock or gravel is used as a base, and paid for on a unit price basis, care should be exercised to keep the quantities within the amounts specified. To do this, the subgrade must be firm and unyielding, rock carefully checked and a careful record kept of the rock dumped between stations.

All wagons should be carefully measured and any shortage deducted from the measured capacity of the wagon or truck. Rock shall be reported and paid for in units of one cubic yard, and no quantities less than one-fourth cubic yard shall be reported and when more than one-fourth cubic yard and less than one-half cubic yard is delivered credit shall be given for one-fourth cubic yard only. To facilitate the work, it is advisable to induce the contractor to deliver rock in whole or half cubic yard quantities.

If the size or quality of the rock being delivered does not conform to the specifications, inspectors will immediately notify the contractor and resident engineer and same should be removed from the job.

The rock base should be rolled until no further movement is noted when a ten ton roller passes over same. If rolling of rock base is done soon after a rain, it sometimes happens that the subgrade is forced up thru the material until it actually shows on the surface of the crushed rock or macadam base. If such a condition exists, all the base should be removed and replaced according to the specifications, as the laying of surface on this kind of base is sure to prove disastrous. Many failures are due to carelessness in this small detail of the work.

FILLS:

Never under any condition allow fills of more than two feet to be paved with any type of pavement until the same has settled through the winter months, without first consulting your Division Engineer and he will only grant that privilege where circumstances are extremely urgent and the contractor will agree in writing to make good any damages to the pavement due to settlement or cracking of the subgrade.

It is impossible to build anything but a rock or hydraulic fill so compactly that settlement will not occur and inspectors and resident engineers are cautioned against experimenting with them.

FORMS:

On all types of bituminous pavements, the inspector will see that all forms are set true to line and grade and avoid unsightly variations in both surface and alignment of the edge of the pavement.

LAYING SURFACE:

Before laying the surface, all loose rock should be removed from the base or rolled into same, and the base should be thoroughly compacted, according to the specifications, otherwise a very rough and unsatisfactory job will result.

In laying the surface mixture, too much stress cannot be laid on the small details that enter into the final appearance, riding and wearing qualities of the pavement.

The thickness should be regulated by allowing a specified number of square yards per batch, or per load of mixture delivered on the road. The inspector should measure the theoretical distance to be covered by each load and make a record of any point that does not conform to the requirements of the inspector. Tickets should be issued showing the number of batches delivered on the road each day and the number of square yards per batch should be shown on the inspectors daily report.

Resident Engineers will give inspectors the theoretical "pull" to be used to get the required thickness of pavement and cut samples at carefully recorded points should be used to verify this calculated thickness.

Rolling should be continued until the asphalt has thoroughly flushed to the surface, and care should be exercised in reversing the roller that waves are not thrown into the pavement surface.

Where flush coat and sand or screenings are added as a top dressing this work should follow closely upon the rolling and in no case should the pavement be allowed to become cold before the top dressing is applied.

Never under any conditions allow pavement to be laid in the rain or on wet base or on base that is not thoroughly compacted.

The finished surface should be watched closely for depressions and high places and the inspector should insist on same being patched while the pavement is still warm.

Where the surface breaks up and shows signs of disintegration, all of the old pavement surface should be removed and replaced with new material replacing the base also, if mud has been forced to the top. In making patches, hand tamping should never be allowed if it is possible to obtain a roller, as hand tamped patches are generally unsightly and rough, and thereby become a lasting blemish on the pavement.

We wish to impress upon all inspectors and Resident Engineers that a few small blemishes or "soft spots" in a pavement will cause the entire job to be condemned by the travelling public although the total length of the work may cover several miles. Therefore, it is essential, both from a standpoint of policy and the much more important one of good engineering, to eliminate all possible chances of failure that can be foreseen.

PULL:

It is well to bear in mind that the "pull" per batch of material varies with the specific gravity of the materials entering into the mixture, type and condition of the base on which the mixture is being laid and to some extent on the amount of compression secured.

However, the pull per 1,000 pound batch of mixture should never exceed 4.2 square yards for bitulithic and 4.6 square yards for asphaltic concrete, based on a thickness of 2 inches. On open crushed rock base, the pull will be reduced about .2 square yard per batch, due to material wasted in filling up the open spaces in the base.

The total weight of the batch, including asphaltum, should be used in determining the number of square yards of surface that can be laid therefrom.

In laying 3 inch gravel bituminous base, a pull of 3.4 square yards per 1,000 pound batch may be secured on good firm, even subgrade, but this pull should never be exceeded unless actual tests show to the contrary.

MIXTURE:

Plant inspectors should make screen tests hourly and compare the results with the requirements as set forth in the specifications, making such corrections in the proportions fed into the elevator as are necessary to get the proper results.

Always bear in mind that it is very desirable to carry a high percentage of material from 200 mesh to 80 mesh inclusive, and that the amount of asphalt must vary to meet changes in these sizes if a satisfactory mix is to be obtained. If the amount of "fines" drops below the minimum specified, the contractor should be forced to close down until suitable material is obtained.

Temperatures should be taken of every second or third load and all others watched for signs of burned or cold loads. These conditions can only be noted after the inspector has tested a sufficient number of loads to become familiar with the appearance of overheated and underheated material. Plant inspectors will also bear in mind that asphalt that is overheated in the tanks will cause the pavement to crack and disintegrate. Tests should be made hourly to ascertain the temperature of the asphalt in the tanks.

Samples of asphalt should be taken from every tank used and tests made on same before it is allowed to go into the mixture. The asphalt scales should be tested hourly as clinging asphalt is continually throwing them out of balance. The amount of asphalt in the tank can be calculated by measurement and the amount used during the day checked against the weighed quantities. This is not essential at all times, but can be used when in doubt.

The stone scales should be tested every day and the weights and sizes of material used watched very closely as it is common practice for the boxman to substitute one size for another when the material is not running evenly. In case a boxman is caught at this, the Resident Engineer will insist on having him discharged.

Representative samples of the mixture should be taken each day and sent into the central laboratory. In taking these samples, the location of the load in the road should be carefully recorded and a copy sent with the sample. Samples can be best secured by catching the material on a shovel as it is being dumped from the mixer, taking about five pounds for a sample. Cigar boxes are very suitable for containers and can generally be secured with no expense at any cigar store.

PAVING HILLS:

Where bituminous pavements are laid on grades exceeding 3 percent, the mixture should be hardened by using additional fine material. The 200 mesh material should be increased from 2 to 4 per cent and a corresponding increase should be made in the material passing the 80 and 100 mesh sieves.

If additional fines cannot be obtained in the material at hand, cement should be used to obtain the proper proportions.

Do not diminish the asphaltic content or increase the amount of coarse aggregate in the mixture as the life of the pavement is easily impaired in that manner.

Our only desire is to harden the mixture to such an extent that it will not creep, or bleed excessively, during warm weather and the proper way to accomplish this result is by maintaining a high percentage of fines in the mixture.

CONCRETE PAVEMENT

SUBGRADE:

The subgrade is the first essential to a good concrete pavement and it should never be laid on poor subgrade.

To build a satisfactory subgrade, for concrete pavement it is always necessary to plow the old roadbed thoroughly whether same is in cut or fill. Leave no hard spots under the pavement or cracks will be sure to result.

After thorough plowing or scarifying, the subgrade should be finished and rolled until a smooth compact surface is obtained and no material should be placed on any subgrade that is not to grade and thoroughly rolled. The roller cannot thoroughly roll more than 500 ft. to 800 ft. per day and time must be deducted from this for going back over previously finished work to roll ruts and soft places that develop in hauling the material onto the subgrade.

Never allow material to be dumped on subgrade that is rutted by hauling or is rough and covered with loose material as this will be picked up in handling the material to the mixer. Subgrade should always be checked with a template and the rolling watched very closely.

FORMS:

See that all forms are set true to line and grade and are maintained in that position until the concrete is finished. Stakes should be driven every four to six feet on the outside of the form and should be 14" to 18" in length.

If stakes are sharpened on two sides only, they will drive more nearly perpendicular.

Firm supports such as stakes or blocks of wood should be driven under the forms at intervals of six or eight feet to keep the forms from settling during the process of tamping and striking off the concrete.

The best type of form is the continuous laminated type and this type should be urged upon the contractor if possible.

These forms are made by nailing two 1½" pieces together lapping joints about ½ the length of the stick. These should be made up in lengths of 200 to 300 feet and can be stripped from the finished pavement and dragged ahead. Forms made in this manner will last the entire season if care is used in making and breaking joints.

See that all stakes on the inside of forms are removed before the pavement is placed.

MATERIAL:

All material delivered on the job should be carefully watched for bark, dirt, chips, clay balls and soft rock. Always bear in mind that the sand or gravel from a given source is continually changing and it is sometimes necessary to abandon the original source of supply altogether. If material is of doubtful character do not hesitate to reject it until laboratory tests can be made on a sample.

A good field test for injurious earthy or vegetable matter in sand is made in the following manner: Have your local druggist make up a 3 per cent solution of Sodium Hydroxide. Procure a graduated 8 or 10 oz. bottle. Fill the bottle to the 4½ oz. mark with sand and

add enough of the solution to bring the total up to the 7 oz. mark on the bottle, shake well and let stand for 24 hours. If the solution is clear at the end of this period, the sand is clean. If it is a light amber color, the sand is passable and if darker the sand should be rejected until a laboratory test can be made.

Do not allow the contractor to change the source of his material without a test being made on same. Your only recourse is to reject the material.

MIXING:

In shoveling the materials off the subgrade, dirt and clods are often included with the sand or rock and a very small proportion of this earthy material will show its effects in the finished road. Clods will work to the top, but cannot be seen while the pavement is being finished as they are coated with cement and when traffic is put on the road, pits will develop in the pavement. On the other hand, if the earthy material included in the mixture is finely divided it will weaken the whole batch and may cause the pavement to ravel and show other weaknesses as the cement cannot properly set when mixed with dirt and loam.

A one cubic foot box with false bottom should be on the job at all times and the size of wheelbarrow loads checked very carefully at least once per day and on such occasions as seem necessary.

Only enough water should be added to the mixture to make the same workable when thoroughly mixed. We have found that about 5.6 gallons of water per sack of cement is about right for ordinary road work. Excess water seriously weakens the concrete and should always be avoided. When enough water is being used so that it is running off the surface of the concrete while being finished, the amount of water should be reduced. Another method of checking the amount of water being user is to note the surface of the finished pavement. If too much water has been used, small water holes will appear.

Always count the sacks of cement used between joints and tie same into a neat bundle, calling contractor's attention to any variation from the required number. If the sacks do not check, your subgrade is low or high, or the material is not being used in the proper proportions.

FINISHING:

The crown of the "strike-off" board should be carefully checked and the pavement made to conform thereto. There is a tendency to overlook slight depressions or fill them up with laitance which wears off as soon as the road is opened to travel, leaving a permanent depression. On the other hand, the "strike-off" board is sometimes not kept firmly on the forms and high places in the pavement result. This should be watched closely and any bad places corrected while the concrete is yet workable.

Contractors have a tendency to require the finishers to make corrections in the surface that should have been made with the "strike-off" board. Watch the surface closely because that is the detail of the finished pavement that will receive the most commendation or censure, providing the quality is good.

JOINTS:

Be careful to have joints placed at regular intervals. In placing joints, care should be exercised to place the joint perpendicular to the center line of the road. Watch closely for high or low joints as the riding qualities of the road depend to a large extent on this item.

CURING:

Closely adhere to the specifications for curing as an otherwise good pavement will be ruined by allowing the pavement to become dry during the first few days and a majority of the trouble occurs during the first few hours after being mixed.

Keep traffic off the pavement until the allotted time has expired and bear in mind that this applies to the contractor as well as the public. Concrete cures more slowly in wet than in dry weather, but in no case should a road be opened for traffic in less than 21 days from date of laying and 30 days is preferable.

Do not open the road to traffic until all rocks, sticks, earth and other material has been removed from the surface of the pavement, as green concrete is easily injured by a heavy load passing over a rock or block of wood, concentrating the entire load on a given point.

BRIDGE WORK

GENERAL

FAMILIARITY WITH THE WORK:

As soon as possible after getting on the job the Engineer should familiarize himself with the plans of the work and also the terms of specifications and contract. He should check up dimensions as far as possible ahead of the progress of the work and thus have time to communicate with the main office any apparent discrepancies.

DIARY:

In bridge work it is especially desirable that a complete diary be kept; this in addition to the ordinary field books. This should include, in addition to conversations with the contractor regarding special or unusual features of the work, progress photographs, if possible, weather and water conditions, cement received and used, changes from original plans, approximate cost of work from day to day, etc.

The duties of the Engineer in charge of the work toward the contractor should be that of a fair and disinterested interpreter of the plans and specifications, but should always bear in mind the possibility of future accidents in connection with the work and legal difficulties and keep his records accordingly. He should aid the contractor to finish his work expeditiously and economically so he will make a fair profit, providing, of course, the State receive satisfactory construction.

UNCLASSIFIED WORK:

In nearly all works of considerable magnitude, contingencies may arise due to alterations in details of construction or other causes where the proposal is not applicable. These items are often referred to in specifications as "Unclassified work" and often are sources of more or less annoyance and ill-feeling between contractor and owner. In giving orders for work of this kind explicit written directions should be given, and a copy sent at once to the General Office. Entries should be made in diary explaining conditions and conversations if any of an unusual nature.

SURVEYS:

In making surveys for bridge sites the assumption should be made that the designer will not visit the site and hence the data indicated below should be given, as well as any special information.

1. Date and elevation of extreme high water.
2. Date and elevation of average low water.
3. If grade has been established, show elevations on profile.
4. Distance from bridge site to nearest railroad station.
5. Condition of road from bridge site to railroad station.
6. Can sand or gravel be obtained locally for concrete? If so, give distance from bridge site.
7. Can timber for various work and piling be obtained locally? If so, give distance from bridge site.
8. Is there a bridge site at this site at present? If so, indicate location on map and profile.
9. Will it be necessary to maintain traffic during the construction of new bridge?
10. If earth fill approaches appear economical, is suitable material obtainable for filling?
11. Indicate direction in which roads will approach the bridge.

12. Indicate nature of foundations; whether silt, clay, rock, etc.

In making up maps the profile should preferably be made on a natural scale and for the smaller structures a scale 1" equals 10 feet should be employed.

MATERIALS OF CONSTRUCTION

SAND:

Sand shall consist of uncoated particles free from lumps of clay and all organic matter. It shall be graded from coarse to fine, one hundred (100) percent should pass a quarter (¼) inch screen, and not more than thirty-five (35) percent should pass a thirty (30) mesh screen. Samples should be taken sufficiently in advance to permit of the twenty-eight (28) day test. They should weigh twenty-five (25) to thirty (30) pounds and should be sufficient to cover the extreme variations in quality of the source of supply. Too much care cannot be exercised in the selection of sand for concrete work as it is probably the cause of poor concrete more often than any other material.

GRAVEL AND BROKEN STONE:

The gravel and broken stone shall consist of clean, hard, tough, durable rock, containing no soft, thin elongated or elaminated pieces and no vegetable or deleterious matter. It should be graded from course to fine, the minimum size being obtained upon a quarter inch sieve, and the maximum passing a 1½ inch ring for Class "A" concrete, and 2½ inch ring for Classes "B and C."

BANK RUN:

Run of bank should, in general, be screened, except for structures of minor importance.

CEMENT:

Cement should be stored in a suitable water tight building with raised floor, in such manner that easy access to count and identification of each shipment may be permitted. Shipments not bearing the test tags of the testing laboratory should be sampled and forwarded to the laboratory at once and no such cement should be used until a satisfactory report is obtained.

A sample should be taken from one (1) barrel in ten (10) and ten (10) such samples should be combined and sent to the laboratory for a test; thus making a test for every one hundred (100) barrels of cement.

In extreme wet weather, especially along the coast, it may be necessary to employ stoves in the storehouses to prevent dampness effecting the cement.

FOUNDATIONS

CONCRETE UNDER WATER:

When the excavations are at the depths required, the water shall be pumped out and the concrete deposited in the open. If, in the opinion of the Engineer, it be necessary, a small amount of concrete sufficient to form a sealing course may be deposited in water by the use of an approved tremie, and after such concrete has set, the water shall be pumped out and the remaining concrete deposited in the open.

During the operation of pouring with a tremie, it is important that the spout must be kept full enough to make a perfect continuous seal.

In all cases of pouring concrete under water, it is very essential that no concrete should be poured in flowing water.

In all cases when concrete is placed under water, an increase of twenty (20) percent of the amount of the cement used for concrete placed above water will be required.

In case a concrete seal is used within the cofferdam, previous to placing the remainder of the base for any pier, cutoff shall be made after seal is placed.

All foundations, where practicable, are to be constructed by open excavation, and shall be shored, braced or protected with cofferdams in accordance with approved methods. Cofferdams shall be sufficiently high to prevent overflow, and consequent damage and delay to the work.

No excavations shall be made outside of caissons, cribs, cofferdams, steel piling or sheeting, and the natural stream bed adjacent to the structure shall not be disturbed if possible.

PILING; MATERIAL, QUALITY AND SIZE:

All piles shall have a fairly uniform taper; and sweep not to exceed one (1) inch for each twenty (20) feet in length of pile. For all lengths the minimum diameter at the point shall be eight (8) inches and the minimum diameter at the cutoff shall be fourteen (14) inches. They shall be free from bark and closely trimmed.

DRIVING:

Piles shall be driven by hammer or combination of hammer and water jet methods, and the driving shall be satisfactory to the Engineer in every case. In driving, the heads of the piles shall be protected from injury by a cap or shall be banded if required. They shall be driven to practical refusal which is here understood to be such as would meet the condition of the Engineering New's

formula for a twenty (20) ton load per pile or 40,000 equals $\frac{2\,wh}{s+1}$ for a drop hammer, or 40,000 equals $\frac{2\,wh}{s+.1}$ for a steam hammer.

w equals weight of hammer in pounds.

h equals drop of hammer in feet.

s equals average penetration for last five (5) blows.

For wood bents or approaches, a load of 25,000 pounds per pile should be employed instead of 40,000 pounds.

If the material encountered warrants, piles shall be shod with metal shoes, to be supplied under the clause for extra material.

The requirements shall not be considered as being fulfilled when the piles rest on logs at a distance insufficient either to give the necessary frictional resistance or lateral stability.

Piles in cribs or open pits or excavations shall be driven by preference after the excavation in the crib is complete. When driven after excavation is complete, the material forced up in the crib or cofferdam shall be removed to correct elevation before the concrete is placed.

Piles for permanent foundations shall not be cut off above low water as a general rule. No pile for these foundations shall have a penetration of less than twelve (12) feet in firm ground, and in case piles having a less penetration are employed, additional ones must be driven.

Allowable pressures:	Tons per sq. ft.
Alluvial soil	½ to 1
Earth and soft clay	1 to 2
Clay or sandy clay	2
Sand or gravel confined	2
Cemented gravel	5
Rock cleaned to solid bed	25

DEPTH OF FOUNDATIONS:

In no case, rock foundations excepted, should footings for piers and abutments be carried to a depth below stream bed less than four (4) feet and generally more, and in all cases to a firm material that will remain confined, otherwise piling must be employed.

STEEL STRUCTURES

Concrete and foundations are discussed elsewhere under the headings "Materials of Construction" and "Foundations," respectively.

ERECTION:

Bases, shoes and all superstructure metal which is to rest on masonry, including handrails on walls, shall be set in exact position and level, and be supported on iron wedges, the space between metal and masonry being filled

with mortar or grout. The spaces in and above the shoes and all parts of the columns capable of containing water shall be filled with 1:2:4 concrete, the aggregate passing through a one (1) inch ring; top surface finished to drain. The cost of this work is included in the price of the steel.

The contractor shall unload and store the material in a careful, systematic way to prevent injury by rust or otherwise and to prevent loss of minor pieces. No stored material shall be permitted to rest on the ground or in water and without proper skids.

Field rivets must be tight and must have both heads concentric with the axis of the rivet. The heads of field rivets shall be of uniform size and have the same dimensions as the shop rivets whenever possible.

All field rivets shall be driven by pneumatic hammers of an approved type and size.

All field bolts shall be full size and of best quality of material. All turned bolts shall fit the holes with a driving fit.

Whenever field holes do not come truly opposite each other in such a way as to prevent the insertion of rivets, such holes shall be enlarged by reaming and larger diameter rivets shall be used, if deemed necessary. Forcible drifting will not be permitted.

In removing rivets the surrounding metal shall not be injured, and if necessary shall be drilled out.

All splices and field connections shall be securely bolted, and when not carrying traffic at least thirty (30) per cent of all holes shall have bolts.

A brass name plate of neat design and finish, giving the names of the Engineer and the contractor, and date, shall be firmly attached to each end of the bridge. All name plates shall be subject to the approval of the Engineer.

Truss spans shall be cambered. The contractor shall prepare camber diagrams along with the shop details, which shall be subject to the Engineer's approval.

Attention is here directed to the preceding general specification for painting, and in particular to painting of parts inaccessible after erection.

PAINTING OF STRUCTURAL STEEL:

All metal work, before leaving the shop, shall be thoroughly cleaned from all loose scale, rust and dirt, and shall be given a coat of the best red lead ground in pure linseed oil to form a paste. Forty pounds of this paste shall be mixed with one gallon of oil to make about two gallons of paint. Nothing but pure turpentine or Japan drier, as required, will be used. Any other approved primer required by the Engineer may be substituted therefor. The coat shall be thoroughly dried before the metal is loaded for shipment. The surface of the metal work shall be thoroughly cleaned by the most effective known methods,

such as wire brushes and scrapers. All surfaces coming in contact shall be well painted before being riveted together. Bed plates, bearing plates and any other parts which are not accessible for painting after erection, shall have three coats of paint, one at the shop, and the other two in the field before erection. The pins, rollers and pinholes shall be coated with white lead and tallow before shipment.

After the structure is erected, the metal work shall be thoroughly cleaned from mud, grease or any other objectionable material that may be found upon it.

All rivet heads upon which paint has been damaged, shall be repainted. Then the entire surface shall be thoroughly and evenly painted with two coats of the field paint to be designated by the Engineer. All three coats of paint given to the metal work are to be of different colors; the second coat must be allowed to dry thoroughly before the third coat is applied.

No thinning of paint will be permitted without the written permission of the Engineer. No painting is to be done in wet or freezing weather, unless it be done under cover, where the temperature is above the freezing point.

All recesses which would retain water or through which water could enter, must be filled with thick paint or some waterproof cement before receiving final painting.

Cleaning and painting shall be done in sections, usually one complete span. The complete cleaning and painting of each coat on each span or specified section, shall be entirely completed and accepted before such span or section may be touched by the succeeding coat. At least seven days, if required, shall elapse between the application of the last portion of one coat and that of the first portion of the succeeding coat.

Cleaning and painting below the floor level shall not be done until after the concrete is placed and the forms removed.

CONCRETE STRUCTURES

CLASSIFICATION OF CONCRETE:

Concrete shall be classified as follows:

Class "A" Concrete shall be made of one (1) part Portland Cement, two (2) parts sand and four (4) parts coarse aggregate.

Class "B" concrete shall be made of one (1) part Portland Cement, two and one-half (2½) parts sand and five (5) parts coarse aggregate.

Class "C" concrete shall be made of one (1) part Portland Cement, three (3) parts sand and six (6) parts coarse aggregate.

Cement, fine and coarse aggregate shall be proportioned by loose volumes. For this purpose one sack of cement shall be considered as .95 of a cubic foot. The fine and coarse aggregate shall be mixed separately. In general the quantities of the various ingredients for one cubic yard of finished concrete are as follows:

Class "A" 1.50 bbl. cement, .42 cu. yds sand, .84 cu. yds. coarse aggregate

Class "B" 1.25 bbl. cement, .44 cu. yds. sand, .87 cu. yd. coarse aggregate

Class "C" 1.00 bbl. cement, .44 cu. yds. sand, .89 cu. yd. coarse aggregate.

MACHINE MIXING:

Approved batch mixers are to be used, except for small work where hand mixing might be permissible. No continuous mixer will be permitted. Mixing shall continue through at least twelve (12) revolutions of the mixer and until every face of every particle of sand and gravel is completely coated with mortar. In all machine mixing the batches of concrete shall be proportioned to the size of the mixer to produce the best results.

HAND MIXING:

If hand mixing is permitted the following method shall be used: The sand and cement shall be thoroughly mixed dry and made into a thin mortar. After the mortar has been brought to the proper consistency, the broken stone or gravel, having been just previously drenched with water, shall be added, and the whole thoroughly mixed to the satisfaction of the Engineer. The mixing shall be done upon water-tight platforms, in a satisfactory manner; after the materials are wet, the work shall proceed rapidly until the concrete is in place, and is so thoroughly manipulated that water flushes to the surface and all the interstices between the stones are entirely filled with mortar.

RETEMPERING:

All mortar and concrete shall be used while fresh and before the initial set has begun. Any mortar or concrete in which the initial set has begun shall be removed from the mixing boards or receptacles and not used in the work. No retempering of mortar or concrete shall be allowed.

CONSISTENCY:

The quantity of water to be used in making concrete shall be such that the mortar will flush to the surface under tamping but without a separation of cement and aggregate.

DEPOSITING:

In general, concrete shall be deposited in horizontal layers. In joining new concrete to old, or to concrete that has already set, the work already in place shall have its

surface cut over thoroughly with picks to remove all laitance, loose and foreign material; this surface shall then be washed and screened with wire brooms before the new concrete is placed.

SUSPENSION OF WORK:

Whenever concreting is suspended on any section for more than one hour, all edges which will be exposed in the finished work shall be brought to a level. In any given layer the separate batches shall follow each other so closely that each one shall be placed and compacted before the preceding one has set, so that there will be no line of separation between the batches. After the concrete has begun to set, it shall not be walked upon in less than twelve (12) hours. Should it be necessary to stop work in a reinforced concrete slab or beam, the break if possible should be made near the center of span and the joint a vertical one.

POROUS CONCRETE:

The operation of compacting the concrete shall be conducted so as to form a compact, dense, impervious artificial stone, which shall show smooth faces on exposed surfaces. The weight of rammers, if used, shall be satisfactory to the Engineer. In any monolith, if any considerable part of the concrete is found porous and has been plastered or is otherwise defective, it shall be removed in whole or in part, as directed by the Engineer, entirely at the contractor's expense.

FORMS:

Especial attention must be paid to bracing, and where the forms appear to be insufficiently braced, or unsatisfactorily built, either before or during concreting, the Engineer shall order work to be stopped until the defects have been corrected to his satisfaction. If desired, small rods to hold the forms may be embedded in the concrete, but in all such cases provision must be made by sleeve nuts or other satisfactory methods for the removal of the two (2) inches nearest the surface. All holes thus left shall be immediately and completely filled with cement mortar and the surface left smooth and even. All forms shall be set and maintained true to the lines designated until the concrete is sufficiently hardened. All forms shall be satisfactory to the Engineer and shall remain in place as long as he deems necessary. This for walls and the side forms of girders and beams should be about two (2) days in summer and five (5) days in cool weather; Slab forms should remain on for one (1) to two (2) weeks, bottoms of beams and girders two (2) to four (4) weeks and columns not taking load four (4) to six (6) days, all depending on weather conditions. The interior surfaces of the forms which come in contact with the surfaces of the concrete which will be exposed in the finished work

shall be of lumber dressed on both faces and both edges and having water-tight joints, and shall be so constructed as to leave all such exposed surfaces of the concrete with a smooth, even finish. Forms re-used shall be maintained at all times in good condition as to accuracy of shape, strength, rigidity, water-tightness and smoothness of surface. Forms unsatisfactory in any respect shall not be used; and if condemned, shall be removed immediately from the work.

In the construction of centering for arch spans or support of viaduct girders and slabs, provisions shall be made for wedging up the blocking to take up any settlement due to defective support or other cause.

Before pouring any concrete, all shavings and debris should be removed from within the forms.

In dry weather, the forms should be well soaked with water the evening previous to pouring and sprinkled from time to time.

FREEZING:

When the temperature falls below thirty-five (35) degrees Fahrenheit the fine aggregate, water and stone shall be heated. In general, concrete shall not be placed during freezing weather but should it be necessary to pour, suitable provisions such as covering or stoves should be employed.

The use of salt or other substances to prevent freezing should be forbidden.

CURING:

All concrete shall be kept thoroughly wetted for not less than twelve (12) days, and in dry weather shall be covered and protected from the sun's rays in addition to the wetting.

FINISH OF EXPOSED CONCRETE SURFACES ON CONCRETE BRIDGES:

The following finish shall be given to exterior surfaces unless otherwise indicated on drawings:

After the forms are removed the concrete must be thoroughly wet with a brush and then rubbed with a coarse No. 16 carborundum stone, bringing the surface to a lather. After this stone has been used sufficiently to take off the rough projections, the lather must be washed off with a brush and the concrete again wet, and then dusted with a mixture of dry sand and cement, the proportions being one (1) part of cement to two (2) parts of sand. This is then rubbed into the surface with a coarse No. 16 stone. Care must be taken not to allow any of the mortar to remain on the surface. The final finish is to be obtained by rubbing the whole surface thoroughly with a No. 30 carborundum stone.

FOUNDATION FOR CONCRETE:

Where concrete is to rest on any excavation surface other than rock, special care shall be taken not to disturb the bottom of the excavation, and the final removal of material to grade shall not be made until just before the concrete is laid, except in concrete foundations for pavement.

The excavation lines and bases of structures shown on the plans shall be considered as only approximate; and they should be placed at any elevation or of any dimensions that will give a satisfactory foundation. All rock or hardpan foundation surfaces shall be freed from loose pieces, cut to firm surfaces and cleaned before laying concrete. All seams shall be cleaned out and filled with concrete or mortar. Where the face of rock or hardpan is on an incline, it shall be terraced off flat.

REINFORCING STEEL:

Steel reinforcement shall be protected at all times from mechanical injury, and, when placed in the work, shall be free from dirt, scale, dust, paint, oil, or other foreign substance.

The laps in the reinforcement not shown on the plans shall have a length of not less than fifty (50) times the normal diameter of the reinforcement, and shall be well distributed or concentrated in the sheer sections.

No rerolled steel will be permitted to be used.

WOODEN STRUCTURES

GRADES OF LUMBER:

Regarding the various grades of lumber which may be called for on the plans, the inspector should consult literature issued by the West Coast Lumbermen's Association.

Shingles should be pre-dipped before being nailed on.

Where carbolineum is to be applied it should be done for best results—when the wood is dry and the carbolineum is hot. The faces and hands of laborers should be well greased with lard or vaseline before starting work.

Where painting is done it is very necessary that the surface is previously cleaned and also that it is dry, and where woodwork is to be painted, a certain amount of thinning with boiled linseed oil is permissible for the first coat but generally not for future coats.

CAMBER:

The camber of wooden truss bridges is to be obtained by increasing the length of the top chord members ¼" in 10 feet in addition to the regular panel lengths.

REPORTS

ENGINEER'S WEEKLY REPORT:

All engineers in charge of construction work shall submit Weekly Reports on Form No. 39. These reports should be mailed to the General Office not later than Monday morning, and should give in concise form, a summary of the progress of the work during the previous week, and on survey jobs, the principal information to be furnished by these reports is relative to camp locations, mail and telephone addresses, etc., but there is also much information relative to the work under way, the attitude of the County officials and of the local people, the reasons for prosecuting or not prosecuting the work in certain ways, etc. What is desired is general information such as an engineer making a personal inspection of the work would expect to have given him.

Weekly Reports should outline in a general way the work that has been accomplished, giving some information relative to unit costs and average quantities. It should also mention any agreements between the engineers and the contractor or between the engineer and property owners, and should give information relative to the success or failure of construction methods used, relative to labor conditions, etc.

DAILY REPORTS ON PAVING AND MACADAMIZING:

Resident Engineers or inspector on paving and macadamizing jobs shall submit to the General Office Daily Progress Reports on Form No. 32.

The purpose of these reports is to keep the office supplied with information relative to the daily and total rock output and the daily and total lineal feet or square yards of surface laid.

The lineal feet of macadam or base rock should be the lineal feet for which the rock or gravel is hauled onto the grade, and may be greater than the lineal feet actually rolled and finished. The total yards of rock given in the report when divided by the number of hundred lineal feet, will then give the average number of cubic yards per station.

Where two or more reports are being sent in from work on one section, as, for instance, from two camps on that section, the particular portion of the work covered should be indicated on each report by the Camp Number or some other distinctive feature.

MONTHLY ESTIMATES ON CONTRACT JOBS:

Monthly estimates covering work done under each contract up to and including the 20th day of each month shall be prepared by the Resident Engineer. In Western Oregon these estimates shall be made up in triplicate, one copy

being retained by the Resident Engineer, the original and duplicate copies being submitted to the General Office. In Eastern Oregon, a fourth copy shall be prepared for the Division Engineer and the copies for the General Office shall be submitted thru the Division Office. After approval by the State Highway Engineer, the duplicate copy will be submitted by the General Office to the contractor for his information.

Monthly estimates shall be made up on the Standard Monthly Estimate Form No. 23, and they shall cover the work done up to and including the 20th of the month, and must be submitted so as to reach the General Office not later than the 26th.

Estimates for work under each contract shall be numbered consecutively, beginning with one. If a contract covers both paving and grading, two estimates must be made up, one covering items chargeable to the paving and the other covering items chargeable to the grading. This is necessary because in nearly every case the paving is paid for from one fund and the grading from another. In numbering estimates of this kind, number the paving estimates "1—Paving," "2—Paving," etc., and the grading estimates "1—Grading," "2—Grading," etc. In case the paving starts a month or two after the grading, give the first paving estimate the same number as the grading estimate for the same month, so that in any given month, both estimates will be of the same number.

Where the same contract covers work in two or more counties, separate estimates shall be submitted each month for work done in each county. In this case, the name of the county shall also become a part of the number, as, for instance, "Estimate No. 4—Grading—Marion County."

The quantities to be listed are the total quantities from the beginning of the job to the date of estimate, not the quantities handled during the month only. The quantities for the month will appear on the line in the totals opposite "Present Estimates." On the line opposite "Previous Estimates" enter the "Total Estimates" for the preceding month. It then follows that the "Previous Estimates" subtracted from the "Total Estimates" gives the "Present Estimates."

The estimate sheet should show quantities in detail. Each culvert should be listed separately, showing the amount of pipe, concrete, steel, excavation, and all other items entering into its construction. Grading should be estimated in as small units as practicable; by individual cuts; by work handled by different sub-contractors; by sections of different classifications; by sections limited by certain natural features; or by such other sections as are best suited to the conditions of the particular work. The purpose of this subdivision of the estimate is to enable the Division Engineer or the contractor to intelligently check up the estimate, to see that work has been estimated whenever it should be. The subdivisions should rarely

exceed one thousand or fifteen hundred feet in length, and should be determined upon early in the work and used the same throughout the job.

Columns should be headed with items as they are bid upon on the proposal sheet in the contract. If concrete pipe is "plain" it should be listed as "plain," if it is "reinforced," it should be listed as "reinforced." The estimate sheet is used as a basis for payment to the contractor. This should be borne in mind in preparing the estimate and no items should be listed unless a unit bid for same appears in the contract. When work is done for which we have no unit bid, such work must be paid for as force account, or a price agreed upon, in writing, with the contractor. Force account bills need not be listed on monthly estimate sheets.

MONTHLY ESTIMATES ON STATE FORCE AND COST PLUS JOBS:

On all construction jobs handled on the Cost Plus Basis, or by State Forces, the Resident Engineer, or the Superintendent, if there is no Resident Engineer on the job, will submit at the end of each month a Monthly Estimate showing in detail the work performed to the end of that month. These estimates shall be made up on the regular monthly estimate sheets, Form No. 23 and shall cover the work done up to and including the last day of the month. They must be submitted so as to reach the General Office not later than the fifth of the month following.

Estimates shall be numbered consecutively beginning with one, and shall bear the name of the job covered, the contract number if it is a cost-plus job, the date, and the signature of the Engineer or Superintendent.

The estimate sheet should show quantities in detail. Each culvert should be listed separately showing the amount of pipe, concrete, steel, excavation, and all other items entering into its construction. Grading should be estimated in as small units as practicable; by individual cuts; by work handled by different subcontractors; by sections of different classification; by sections limited by certain natural features; or by such other sections as are best suited to the conditions of the particular work. The purpose of this subdivision of the estimate is to enable the District Engineer to intelligently check up the estimate, to see that the work has been properly estimated. The subdivision should rarely exceed one thousand or fifteen hundred feet in length, and should be determined upon early in the work and used the same throughout the job.

The quantities to be listed are the total quantities from the beginning of the job to the date of the estimate. All columns should be clearly headed with the names of the items covered, stating sizes, units, etc. All estimates should be carefully checked against the estimate for the months previous. On the line for "Preliminary Estimates"

show the total quantities in the completed work, according to the best information available each month. This "Preliminary Estimate" should be corrected from month to month as the work progresses and better information is obtained.

Every item of work performed should be included in these estimates as they are to be used in computing unit costs. The estimates should be conservative, however, and Engineers and Superintendents are cautioned against over estimating and over classifying their work to show low unit costs.

MONTHLY QUANTITY SUMMARY:

Resident Engineers on construction jobs will prepare each month revised estimates showing the total amount of work in the job, the amount completed to date, and the amount remaining to be done.

This report is to be prepared on the Standard Quantity Summary Sheet, Form No. 42. A single copy is to be furnished the General Office; one copy retained by the Engineer, and where the work is being handled through a Division Office, one copy furnished the Division Engineer. The report is to be submitted with the "Monthly Estimate" so as to reach the General Office not later than the 26th of the month and is to cover work done up to, and including, the 20th of the month.

The purpose of this report is to keep the office informed as to just how the quantity and financial ends of each contract job are progressing. As the work develops the Engineer in charge secures more accurate information as to the quantities and classification, and each month becomes able to estimate more closely the total cost of the job. For the purpose of handling appropriation and funds it is important that we have the best available information in this regard, that is obtainable.

Under the column heading "Item" list the various construction items involved in your work as "Clearing and Grubbing," "Common Excavation," "Broken Stone Macadam," etc. Under the heading "Unit" give the unit of measurement as "cu. yd.", "lin. ft.", "sq. yd.", etc. In the "Unit Price" column enter the prices as bid on each item by the contractor.

In the "Preliminary Estimate" columns give the quantities as bid on by the contractor and the corresponding amounts in dollars and cents. The items in these columns will be the same each month.

In the "Estimate Corrected to Date" columns, give the quantities and amounts as they are revised and corrected each month from actual determination of quantities by cross-sectioning and from the more accurate information obtained as the work is opened up. The items in these columns will change from month to month.

In the columns headed "Completed to Date" show the

total estimated quantities as given in your Monthly Estimate, together with the corresponding amounts in dollars and cents. The column headed "To Complete Work" represents the difference between the columns "Estimate Corrected to Date" and "Completed to Date," and gives the quantities of work still to be completed and the corresponding cost of same.

It is important that every possible item of cost that can go against a job be included in this summary, so that the total cost of the work as shown by it will be the actual total. The Resident Engineer is in better position to know what the total cost of the completed job will be than anyone else, and the responsibility of having correct information on this, is placed upon him, and he is expected to keep the office fully advised of any changes that must be made in the estimated cost of the work so that no shortage of funds will develop.

FORCE ACCOUNT ORDERS:

Work on contract jobs which cannot be paid for at unit prices or for which no unit price is included in the contractors' proposal, will be allowed upon the written order of the State Highway Engineer, the Division Engineer, or the District Engineer, and will be paid for as "Force Account Work" or "Extra Work."

The force account order shall be made up by the Resident Engineer on the Standard Form No. 24, for that purpose, and shall be recommended for approval by him. The order shall bear in addition to the information provided for on the form, a specific statement of the nature of the work to be done, the station numbers of the portion of line involved, and reasons for allowing the work as force account, unless this is clear.

The original (white sheet) and the duplicate (blue sheet) copies shall be sent to the District or Division Engineer or to the General Office for approval. The triplicate copy (yellow sheet) shall be retained by the Resident Engineer. On the copies for the Resident Engineer and the General Office, but not on the contractors' copy (white sheet), shall be given an estimate of the quantities of work involved and its cost.

To avoid any misunderstanding as to responsibility and authority, the Resident Engineer shall secure the written approval of the State Highway Engineer, Division Engineer, or District Engineer before allowing a contractor to proceed with work upon which he expects to receive force account payment.

Force Account Orders will be numbered numerically, orders under each contract beginning with one. The Resident Engineer will place upon each force account bill the number of the contract and the number of the force account order authorizing the work. If a single bill covers work under more than one order, the amounts chargeable to each order must be given.

FORCE ACCOUNT BILLS OR BILLS FOR EXTRA WORK:

All bills for Force Account work will pass through the hands of the Resident Engineer for his approval. It is necessary, therefore, that the Resident Engineer keep a careful record of all time, equipment, material, etc., entering into each force account job and that he keep in his files a copy of each bill that he approves to prevent any possibility of duplication of charges. Two copies of each bill must be submitted to the General Office for payment.

Bills covering labor and teamhire must give the names of the men employed, the dates upon which each man worked, the total time, and rates of pay. Accident Insurance in accordance with the Workmen's Compensation Law will be allowed.

Bills covering material must give the dates upon which the material was furnished, the quantities, and unit prices. The contractor will be allowed 10% on all labor and team hire and also on industrial accident insurance. Five percent will be allowed on the cost of all materials entering into the work.

A force account bill cannot be paid unless a force account order has previously been issued authorizing the work. The number of the force account order, together with the contract number must be noted on the face of each bill. If a bill covers work under two or more orders, the amounts chargeable to each order must be given.

As payments on contract jobs are made only once a month, and that immediately after the receipt of the Monthly Estimate, it is necessary that force account bills be in the General Office not later than the 26th of the month to insure payment on that month's estimate. Force account bills reaching the office later than the 26th will be held over until the following month. The contractor should therefore close his force account payrolls about the 20th of the month, and the Resident Engineer should so instruct him.

DIARY:

Each Field Engineer will keep a diary which will be submitted along with other records at the close of the job. In this diary, he will each day make note of all matters concerning his work which could possibly be of value for reference at a later date. This will include a general outline of the progress of the work, conversations held with parties interested in the work, the beginning or ending of certain portions of the work, settlement of various problems which arise, giving or receiving of orders, arrival or departure of members of party, inspection of structures, submission of reports, etc.

The information contained in an intelligently kept diary is at times invaluable in lawsuits, the settling of disputes, and the checking up of dates.

Books of diaries will be furnished upon requisition.

FINAL RECORDS

RECORDS TO BE SUBMITTED:

During the progress of the job, the Resident Engineer shall work up a complete set of final records and have them in such shape that they may be completed and turned into the General Office immediately after the construction work is finished. These final records will consist of

1. Construction map.
2. Construction profile.
3. Final Cross-sections.
4. Field Notes.
5. Duplicates of Material Receipts.

These records should be prepared in accordance with the instructions for each, as given below.

CONSTRUCTION MAP:

As one of the final records, a complete map should be submitted at the completion of each job. This map may be the original location map showing all revisions and corrections, or it may be a new map, but in either case, it must show the alignment as constructed. The conventions and general arrangement of the map should be as shown on the "Standard Form of Map."

CONSTRUCTION PROFILE:

Each Resident Engineer shall prepare and have ready to submit at the completion of each job, a final construction profile. The data shown on this profile shall be for the line as constructed and all quantities must check with the final estimate. All items estimated must appear in detail on the profile. Each culvert must show the quantities of concrete, pipe, excavation, etc., entering into its construction. The roadbed section must be shown thereon with indication of the relation of the section to the profile grade. All reference points and bench marks should also be shown.

The construction profile is the most important of the final records of work to be submitted, and must not be neglected. The profile must be prepared in accordance with the "Standard Form of Profile."

FINAL CROSS-SECTIONS:

Upon the completion of grading jobs, there must be submitted to the General Office, a complete set of platted cross-sections and a detailed summary of the final estimate quantities with such plats and cross-sections as are necessary to account absolutely for every item upon which payment has been made to the contractor.

These cross-sections and estimate summaries shall be made up on sheets of green cross-section paper, 10″x14″

(inked in), and filed or bound for convenient reference. If the work has been handled by station gangs, the quantities should be summarized by sections as handled by the different gangs, so that each sub-contractor's estimate is shown in detail. Plats should be made showing excavation for culverts, headwalls, inlet and outlet ditches, bridge footings, porous tile drains, etc., with sufficient information to enable a complete check of the quantities to be made.

The summary sheets should show the excavation quantities by cuts and the embankment quantities by fills, and should give the quantities of concrete, reinforcing metal, culvert pipe, lumber and timber, excavation classification, etc., for each structure or other detailed part of the work.

The cross-sections may be platted on a five or a ten foot to the inch scale as is best suited to the particular job. The cross-section readings should preferably indicate the distance above or below grade and the distance right or left from the center line, but where more convenient, may be referred to actual elevation.

On contract work, the areas must be computed to hundredths of square feet (not planimetered) and the quantities must be carried out to tenths of cubic yards. The excavation and embankment areas must appear on each section and the excavation and embankment volumes between the respective end sections. The quantities should be totaled by cuts and fills and the classified quantities shown.

The average end area method of quantity computation will be used. Corrections for curvature will not be made except on instructions from the Division Engineer.

Pyramids at grade points will be figured as such where the ground is such that the pyramid method gives the full quantity. This should be noted in the field book when the sections are being taken and should also be noted upon the cross-section sheet.

All cross-section computations should be carefully checked so that the recheck in this office will not show up carelessness.

Overbreak is to be measured up and allowed as "Common" Excavation. Overbreak quantities should be shown on the sections separate from the quantities within the cross-sectioned slopes.

As far as possible, the lines of demarcation between excavated materials of different classifications should be shown on the cross-sections, and the actual quantities of classified material computed.

FIELD NOTES:

All field notes must be turned in to the Division or General Office upon the completion of the job. These books must be fully indexed and so arranged that final notes are easily distinguished from preliminary and other notes that have been revised. Notes referring to preliminary

and revised sections of lines, must be in such shape that they can readily be traced thru by parties not familiar with details of the work as performed. Each page of notes should bear the date on which the field work was performed. Each book must bear upon the first leaf the name of the County, highway, section and Engineer, and must state the kinds of notes contained in the book.

An index to all books, profiles, maps and other records should be prepared and submitted with the other records.

ROCK RECEIPTS:

On all surfacing jobs, where broken stone or gravel is being paid for at unit prices, the Engineer or his inspector will give receipts to the party furnishing the stone or gravel as the material is delivered on the job. Rock tickets (Form No. 53) will be used for this purpose, the receipt being given to the driver as each load is delivered and a duplicate retained by the Engineer. The purpose of these receipts is to prevent dishonest contractors from claiming payment for materials which have not been furnished. Payment will not be made for material for which the contractor can produce no receipts.

At the close of the job, the Engineer will submit with his final estimate, the duplicates of all receipts issued, and the total of the yardages shown on these stubs should be the same as the final estimate quantity for that particular material.

FEDERAL AID PROJECTS

Before proceeding with the surveys, the preparation of plans, or the construction work for projects on which Federal Aid is contemplated, the Engineer should familiarize himself with the requirements of the Federal Government concerning such projects. These requirements are outlined in the following paragraphs from official instructions from the Federal Bureau of Public Roads.

REGULATIONS GOVERNING THE GENERAL PROCEDURE ON POST ROAD PROJECTS

PROJECT STATEMENTS:

A project statement shall contain all information necessary to enable the Secretary to ascertain (a) whether the project conforms to the requirements of the Act; (b) whether adequate funds, or their equivalent, are or will be available by or on behalf of the State for construction; (c) what purpose the project will serve and how it correlates with the other highway work of the State; (d) the administrative control of, and responsibility for, the project; (e) the adequacy of the plans and provisions for proper maintenance of roads; and (f) the approximate amount of Federal Aid desired.

Suitable forms for project statements will be supplied by the Bureau of Public Roads.

Project statements may be submitted at any time, but not in excess of funds previously apportioned to the State.

Each project statement shall be accompanied by a sketch map, showing the location of the proposed project and all main contiguous transportation features.

Where any part of the cost of a project is to be furnished by a county or other local subdivision or subdivisions of a State, the project statement shall be accompanied by certified copy of each resolution or order, if any, of the appropriate local officials respecting the funds which are or will be made available, or respecting the supervision of the construction of the road and of the expenditure of the money provided or to be provided for paying such cost.

SURVEYS, PLANS, SPECIFICATIONS, AND ESTIMATES:

Surveys and plans shall show, in convenient form and sufficient detail, according to accepted engineering practice, necessary data, in connection with the specifications and estimates, to enable the Secretary to ascertain and pass upon location, grades, drainage, bridges, other structures, special and unusual features, the work to be performed, and the probable cost thereof, all in conformity with the standards governing form and arrangement prescribed by the Secretary, except that state standard specifications submitted and approved prior to July 1, 1919, need not conform to the Standards prescribed by the Secretary; and such approved State standard specifications may continue in force after July 1, 1919, so long as they remain unchanged.

Specifications shall set forth the proposed method of construction, type of construction, materials to be used, and other essentials, in such detail as to afford complete knowledge of all steps to be taken in the construction of the project.

The estimate for the proposed type, or types, of construction for each project shall show the estimated quantity and cost of each item of construction in detail and, separately, the ten per cent fund, and shall not include any expense of advertising.

Unless State standard contract and bond forms have been approved, there shall be submitted, with each set of specifications, for the approval of the Secretary copies of the form of contract, together with all documents referred to therein or made part thereof, and of the contractor's bond which it is proposed to use on the project. No alteration of such form shall be made until it is approved by the Secretary.

Rights-of-way necessary for any project shall be provided, and any incidental damages to adjoining property due to construction work paid, by or on behalf of the State, and the expense thereof shall not be included in the estimate or paid in part, directly or indirectly, by the Federal Government.

Grade crossings shall be avoided where practicable. The estimated cost of eliminating a grade crossing shall not include any amount the State, county or other civil subdivision has received, is to receive, or is entitled to receive, directly or indirectly, as reimbursement or payment from the owner of a public utility, for or on account of such elimination.

No part of the expense of making surveys, plans, specifications or estimates, by or on behalf of the State prior to the beginning of construction work, shall be included in the estimate or paid by the Federal Government.

When plans, specifications and estimates have been approved by the Secretary no alteration thereof shall be made without his approval, except that minor alterations which will not involve an increase in the cost of the project

to the Federal Government may be made with the approval of the Director of the Bureau of Public Roads, or of his authorized representative.

PROJECT AGREEMENTS:

A project agreement between the State Highway Department and the Secretary shall be executed in triplicate on a form furnished by the Secretary. No payment shall be made by the United States unless or until such agreement has been executed, nor on account of work done prior to the recommendation by the District Engineer of the Bureau of Public Roads that the project plans, specifications, and estimates be approved.

CONTRACTS:

No part of the Federal money set aside on account of any project shall be paid until it has been shown to the satisfaction of the Secretary that adequate means, either by advertising or by other devices appropriate for the purpose, were employed, prior to the beginning of construction, to insure the economical and practical expenditure of such money.

Immediately on publication of advertisements, copies thereof shall be furnished to the Bureau of Public Roads.

Bids shall conform to the standard proposal form and the items shall be the same as those contained in the estimate provided for in Reg. 5, Sec. 3.

Copy of the tabulated bid prices, showing the unit prices and the totals of each bid for every project, shall be furnished promptly to the Bureau of Public Roads.

In advance of the acceptance of any bid, sufficient notice of the time and place the contract is to be awarded shall be given to the Bureau of Public Roads to enable it, if it so desire, to have a representative present. When a bid has been accepted prompt notice thereof shall be given to the Bureau of Public Roads.

If the contract be awarded to any other than the lowest responsible bidder, the Federal Government shall not pay more than its prorata share of the lowest responsible bid, unless it be satisfactorily shown that it was advantageous to the work to accept the higher bid.

A copy of each contract as executed shall be immediately certified by the State Highway Department and furnished to the Bureau of Public Roads.

The specifications and plans shall be made a part of the contract.

No alteration in such contract shall be made without the approval of the Secretary.

CONSTRUCTION WORK AND LABOR:

Suitable samples of materials to be used in construction work shall be submitted, by or on behalf of the State Highway Department, to the Bureau of Public Roads whenever requested.

Unless otherwise stipulated in writing by the Secretary or his authorized representative, materials for the construction of any project shall, prior to use, be tested for conformity with specifications, according to methods prescribed, or approved, by the Bureau of Public Roads.

Unless otherwise specifically stipulated in the project agreement, bridges, viaducts and underpasses shall have clear width of roadway of not less than 16 feet, and clear head room of not less than 14 feet for a width of 8 feet at the center.

No part of the money apportioned under the Act shall be used, directly or indirectly, to pay, or to reimburse, a State, county or local subdivision for the payment of, any premium or royalty on any patented or proprietary material, specifications, process, or type of construction, unless purchased or obtained on open actual competitive bidding at the same or a less cost than unpatented articles or methods equally suitable for the same purpose.

The supervision of each project by the State Highway Department shall include adequate engineering and inspection throughout the course of construction.

BUREAU OF PUBLIC ROADS:

Papers and documents required by the Act or these regulations to be submitted to the Secretary may be delivered to the Bureau of Public Roads and from the date of such delivery shall be deemed submitted.

RECORDS AND COST KEEPING:

Such records of the cost of the work, and of inspection and tests by or on behalf of the State, shall be kept, by or under the direction of the State Highway Department, as will enable the Secretary, or his authorized representative, at any time to determine the condition of the construction and maintenance of, and the cost to the State and the Federal Government of the construction work and labor done on, any project.

The accounts and records, together with all supporting documents, shall be open, at all times, to the inspection of the Secretary, or his authorized representative, and copies thereof shall be furnished when requested.

Certified copies of payrolls on force account work and of all vouchers for other expenditures shall be furnished, whenever requested by the Secretary or his authorized representative.

Whenever requested by the Secretary or his authorized representative, unit costs on any project shall be kept, on forms furnished by the Bureau of Public Roads.

PAYMENTS:

Vouchers, in the form provided by the Secretary and certified as therein prescribed, showing amounts expended on any project and amount claimed to be due from the Federal Government on account thereof, shall be submitted

by the State Highway Department to the Bureau of Public Roads, either after completion of construction of the project or, if the Secretary has determined to make payments as the construction progresses, at intervals of not less than one month.

BUREAU OF PUBLIC ROADS:

Papers and documents required by the Act or these regulations to be submitted to the Secretary may be delivered to the Bureau of Public Roads and from the date of such delivery shall be deemed submitted.

STANDARDS GOVERNING THE FORM AND ARRANGEMENT OF PLANS FOR POST ROAD PROJECTS

PLANS TO CONSIST OF:

The plans will consist of a title-page, typical cross section of improvement, plan and profile, cross sections, and such structural plans and State structural standards as may be necessary to properly show the proposed construction.

SIZES:

All plans or drawings will be on flat sheets 22x36 inches outside dimensions. Border lines are to be so placed as to provide a binding margin 2 inches wide at the left-hand end and a margin one-half inch wide on the remaining three edges of all plans. On cross-section sheets the border lines may be omitted, but sufficient space should be allowed for the 2 inch binding edge at the left-hand end of the sheets. State Highway Department standard sheets, showing structural standards, may be made a part of the plans and be attached thereto, provided the size of these standard sheets does not exceed the size required for plans.

NOTATIONS:

The plans are to be used upon suitable surveys, and all notation necessary to make the required details clear is to appear appropriately throughout the plans.

Any information which the State Highway Departments may deem necessary for their own uses may be incorporated in the plans, in addition to that herein prescribed, provided it does not interfere with their legibility.

SUBMISSION:

The sheets composing the set of plans should be bound in the following order: Title-page, typical cross-section of improvement, road plans, State standards, special structural plans and cross sections.

Blue prints of all plans, with the exceptions noted below, are to be submitted in triplicate, one copy of which will be returned when approved. One set of cross-sections only is to be submitted. State standard plans, if on file in the Bureau of Public Roads may be omitted entirely, but necessary additional copies of standard or special structural plans are to be submitted upon request of the Bureau of Public Roads. Each copy of a set of plans should be accompanied by a copy of the specifications unless State standard specifications previously approved or specifications previously approved for another project are to be used and are on file in the Bureau of Public Roads, in which case references to the Standards or specifications should appropriately and clearly appear on the title page, typical cross-section page, or first page of the road plans.

TITLE PAGE:

The title-page for the set of plans shall show, conveniently arranged, the title, scales, a layout map, and index of the drawings, a key to the conventional signs used, the number of the project in the upper right-hand corner, and, in the lower right-hand corner, a sufficient number of blank spaces for the dates and signatures of the approving State officials, and blank spaces for the dates and signatures of three approving Federal officials with their titles.

The layout map shall show the layout of the project, indicating county and State lines where contiguous to the road, north point, principal connecting and adjacent roads, principal streams, railroads, cities, and towns, and shall be of such scale as to permit its being shown on the title-page.

TYPICAL CROSS-SECTIONS:

A typical cross-section of the improvement shall be placed on the first sheet directly following the title-page. This section, on a suitable scale, should show the various slopes for cut and fill, the width of graded section in cut and on embankment, the crown or shape of the finished surface, shoulders, gutters, etc., between slopes, the width and thickness of the various courses of pavement or surfacing, and the position of the profile grade line relative to the typical cross section, together with any desired additional details.

When more than one typical cross section is used, the proposed location for each should be indicated.

On this sheet also may be shown, if desired, any special information, such as summary of quantities, etc.

The typical cross section and other details here provided may be placed on the first sheet of the road plans provided they do not interfere with the plan of profile.

ARRANGEMENT OF PLAN AND PROFILE:

The plan and profile shall be placed on the same sheet. The plan shall be shown across the top of the sheet and the corresponding profile directly below. When the conditions permit, without interference or over-lapping, two sections of the plan and profile may be shown on the same sheet.

A suitable standard profile ruling may appear across the lower portion of the sheet if desired, but the upper portion showing the plan should in no case bear profile ruling.

SCALES:

The plans shall be drafted to a scale of 1 inch equals 40, 50, 80, 100, 200 or 400 feet, at the option of the State Highway Department and the profile shall be drafted to the same scale horizontally as the plans, and to a vertical scale having a ratio with the horizontal of 1 to 5 or 1 to 10. Choice of scales should be made with regard to topography and type of work and to the data required on the plans. A distorted lateral scale may be used on the plans provided it is not greater than twice the longitudinal scale.

DATA ON PLAN:

The plan of the road shall show the center line of construction, bearing of tangents, right-of-way lines, stations of beginning and ending of curves, approximate radii of curvature, station points, equations of stationing, streams, and railroads on or near the right-of-way, poles for wire lines, and other obstructions on the right-of-way. Structures outside of the right-of-way need be shown only when affected by the proposed construction. The location of proposed new culverts and bridges with their sizes, also the location and sizes of old culverts or bridges which are to be left in place and used, are to be shown. Any old road surfaces or portions of pavements to be used in place in connection with the proposed construction and all unusual or special features which can be anticipated such as guard rails, retaining walls, ditch protection and subdrains shall be shown. Such of these items as lend themselves readily to location by description may be tabulated or noted but the tabulation and notation should appear on each sheet of the plan concerned. In minor changes of location requiring new or additional right-of-way the margins of the old roadway shall be shown by light broken lines.

The plan should be platted with the stationing from left to right. A north point should be placed on each sheet. All curve points or angles on the construction line and the 100 or 500 foot station points should be marked.

DATA ON PROFILE:

The profile is to show surface line, grade line, length of vertical curves, percentage of gradient, datum line and station ordinate lines, in all cases. When the profile is

made on plain tracing cloth or paper, then surface elevations and grade elevations at station ordinates, and at charges of gradient, shall be shown; but when the profile is made on tracing cloth or paper having standard profile ruling for the required scales, surface elevations may be omitted and grade elevations shown only at changes of gradient. The surface line of streams beds under existing bridges, as well as that of the bridge floors, should be shown.

Where possible, balance points of excavation shall be indicated on the profile with the quantities involved.

The "Grade Line" shall represent the profile of the surface of the finished pavement or surfacing along the center line of the proposed construction, or the profile of the subgrade as prepared for surfacing along such center line.

In every case a notation shall clearly indicate whether the grade line represents the surface of finished pavements or subgrades.

The "Surface Line" shall represent the profile of the to be essentially the same as the old location, although the centers may deviate slightly. Where relocations or realignments are made which will cause the center line of the roadway to be essentially different from the center of the surface of the ground along the center of the present traveled way where the new location of the roadway is present travelled way, the surface line shall represent the profile of the ground along the center of the proposed roadway. The surface line is to be drawn as a series of straight lines.

CROSS-SECTIONS:

For original plans, cross sections shall be taken at such intervals as may be necessary to show accurately the character and extent of the intended work. The cross sections shall be platted to a horizontal and vertical scale of one inch—10 feet or to any longer scale at the option of the State Highway Departments. They shall be platted from the bottom of the sheet upward, and so as not to interfere unduly with one another. Either the lower side or the right hand end of the sheets may be used as the bottom in platting.

The cross sections shall be drafted to show the ground surface and either (a) the template lines of the proposed typical section or (b) a flat subgrade line so located with reference to the profile grade as to give a cross sectional area equivalent to that given by the template of the proposed typical section. In both cases the side slopes, ditches, etc., shall show, the ground line shall be extended slightly beyond the slope intersections and if the second case is used, the adjusted flat subgrade line shall be shown on the typical section. Each cross section shall be marked with its station location, "grade line" elevation and the yardage between sections. Any additional information may be shown.

STRUCTURAL PLANS:

Structural plans shall be submitted as indicated under the following conditions:

(1) For culverts or drainage structures with clear spans not exceeding 20 feet, measured along the center line of roadway, there shall be submitted either complete detail plans or standard plans giving all essential information. If standard plans or plans previously approved for another project are to be used and are on file in the Bureau of Public Roads, they need not be furnished with the plans for each project, but may be used by reference only.

(2) For bridges with spans exceeding 20 feet, the complete set of plans shall contain the following: Plan of bridge site, profile of crossing, cross-sections, complete stresses, design and general details, shop and all minor details, and such other drawings as may be essential to make the information complete and intelligible. While it is expected that plans will be submitted and approved and project agreements executed before bids are requested, the following exceptions will be allowed:

(a) Shop and minor details may be submitted after the contract is awarded but before work is begun on materials.

(b) When it is impracticable, as sometimes occurs in the case of movable spans, to submit plans and specifications previous to receiving bids, such plans and specifications may be submitted after bids are received, provided the State Highway Department shall notify the Office of Public Roads in advance as to all the steps to be followed in securing such bids, in the same manner as if the project agreement had been previously signed.

(3) For bridges requiring the approval of the Secretary of War, data required by him should, if practicable, be submitted for approval prior to its submission to the War Department. The remaining plans should be submitted as herein called for after authority has been granted by the Secretary of War.

When designs for culverts and bridges are submitted, they should be accompanied by three sets of specifications.

SPECIFICATIONS:

At the time plans are submitted they shall, except as previously noted, be accompanied by three copies of the specifications, proposal, and any necessary papers pertaining thereto, printed on paper 8½ by 11 inches in size, bound along the left-hand side.

Specifications shall be arranged in accordance with the instructions and outline following:

General headings, conforming to those in bold-faced type, are to be used in the order and form in which they appear in this outline. Under each of the general headings the subject matter in the order indicated is to be covered in separate paragraphs with suitable subheadings. It is not required that all subjects in light-faced type be covered, nor

is it required that all general headings under "Construction details" be used in the specifications, but such subjects and general headings as are used should appear in the order indicated.

When desired, additional subjects under any of the required general headings should be placed with proper subheadings following those suggested, and in the "Construction details" additional general subjects with suitable general headings should be placed following or in place of "Miscellaneous items."

The specifications, proposal, contract, and bond, prepared as indicated herein, shall be assembled and bound together for submission, but may be made up from separate sheets, sections, or pamphlets. In any case the outline indicated under each separate part should be followed, and the parts assembled in the order given. If desired, a separate specification for all materials may be prepared, and references to such material details may be made in the construction details under "materials"; in which case, the "Material details" should be placed immediately following the "Construction Details," as indicated herein.

REGULATIONS GOVERNING THE GENERAL PROCEDURE ON FOREST ROAD PROJECTS

APPLICATIONS:

Application for the survey, construction, and maintenance of roads under the Act shall be made by the proper local authority to the Secretary, upon forms furnished by the Forest Service, and filed in the district office of the Forest Service for the district within which the proposed road is located. Any application by a county in a State having a State Highway Department shall, before filing, be referred to such department for its recommendation, which shall be filed with the application.

Each application shall contain: (a) Satisfactory evidence of authority to make application on behalf of the State, Territory or county, and to enter into a cooperative agreement with the Secretary for the survey, construction and maintenance of the proposed road; (b) a statement of the public needs to be served by the proposed road and the manner in and extent to which such road is necessary for the use and development of the resources upon which communities within or adjacent to the National Forests

are dependent; (c) a statement showing (1) the general location of the proposed road, (2) its termini, length, grades, and estimated cost, and (3) the name, population, and location with respect to the proposed road of each community that would be benefited thereby; and (d) proposals for cooperation, giving in detail the amount and extent of the cooperation offered, whether in money, materials, labor, or the construction of a cooperative road, and whether cooperative moneys will be held and disbursed by the local authority or will be deposited in the United States Treasury in accordance with the provisions of the Act of Congress approved June 30, 1914 (38 Stat. 415, 430), entitled, "An Act making appropriations for the Department of Agriculture for the fiscal year ending June thirtieth, nineteen hundred and fifteen," creating a special fund of contributions for cooperative forest work, available until expended, for the payment of the expenses of such work and for refunds to the contributors of amounts paid by them in excess of their share of such work.

Applications which are not approved for the fiscal year for which made will be retained and, unless modified or withdrawn by the applicant, will be considered for succeeding fiscal years.

SELECTION OF PROJECTS:

The Forest Service shall prepare: (a) A project plan for each State, providing as far as practicable, for a comprehensive road system in the National Forests, showing, in the order of their importance the roads within or partly within the National Forests which it believes should be constructed; (b) maps showing the road system for each National Forest, and deliminating the projects listed, with a mark or marks of identification for each; and (c) a statement for each county in which there is a National Forest, showing the maximum amount which may be expended therein under the Act. Such project plans, maps, and statements shall be submitted to the Secretary for approval, and after such approval shall be transmitted to the Office of Public Roads for its information.

Unless satisfactory data are already available, reconnaissance surveys and preliminary cost estimates shall be made, by or under the direction of the Office of Public Roads, of all road projects for which proper application has been made.

A list of the projects applied for, arranged as to each State in the order in which construction is recommended, shall be forwarded each year for presentation to the Secretary. The project list as approved by the Secretary shall determine the order of construction for each year.

COOPERATIVE AGREEMENT:

Upon the approval of any project list, a cooperative agreement for execution by the Secretary and the local

authority shall be prepared by the Solicitor from data furnished by the Forest Service and the Office of Public Roads for each of those projects, in the order listed, for which funds are or will be available, and shall provide for: (a) Surveys, plans, construction and maintenance of the project to be done in accordance with these rules and regulations; (b) amount, value and character of cooperation; (c) furnishing of labor and materials, the deposit of cooperative funds in the Treasury, or the disbursement of such funds by the local authority; (d) supervision and inspection during construction and approval upon completion; (e) final accounting to each party to the agreement of all labor or materials furnished and all moneys expended under the agreement; and (f) such other terms as in the opinion of the Secretary should be included.

The basis of cooperation shall be the reconnaissance survey estimate of the cost of final survey and construction. Cooperation shall be expressed as far as feasible in percentages. If the location survey estimates exceed the reconnaissance estimates by twenty-five per centum or more, the Secretary shall so notify the local authority, and at any time within thirty days either party to the agreement may apply for a modification thereof. If modifications can be agreed upon, a supplementary agreement, if necessary, shall be drawn; otherwise, either party may withdraw from the agreement upon thirty days' notice. In case of such excess, construction shall not be started nor advertisements made for bids until final agreement is reached.

Each local authority will be required to cooperate as herein defined in an amount at least equal to fifty per centum of the estimated cost of the final survey and construction and the entire cost of maintenance of National Forest roads, unless a satisfactory showing is made to the Secretary that such an amount of cooperation is inequitable. Cooperation by local authorities may be in the form of money, labor, materials, or the construction of cooperative roads, and the amount and value thereof shall be fixed by the Secretary. Cooperation in the form of road construction will be accepted only when such cooperative road connects with and is an extension of a National Forest road, and to the extent only that such road is necessary to furnish a connection between a National Forest road and the general State, Territory, or county road system. Such cooperative road may be either within or without National Forest boundaries.

SURVEYS, CONSTRUCTION AND MAINTENANCE:

Upon the execution of a cooperative agreement the Office of Public Roads shall proceed with the survey and construction of the road in accordance with such cooperative agreement.

National Forest roads shall be constructed under the supervision of the Office of Public Roads, in accordance

with plans prepared by it and aproved by the Forest Service. The maintenance of such roads shall be under the supervision of the Office of Public Roads, unless otherwise provided in the agreement.

Cooperative roads shall be constructed in accordance with plans made as provided in the cooperative agreement and approved by the Office of Public Roads and the Forest Service. Such roads shall be subject to approval by the Secretary on completion, and to inspection by the Office of Public Roads during construction and maintenance. Cooperative roads shall be maintained by the local authorities.

If a cooperative road is constructed as provided in the preceding section, or any road constructed under a cooperative agreement is not properly maintained in accordance with its terms, or there is failure to comply with any other of its terms, the Secretary will give notice of such fact to the proper local authority. If within four months from the receipt of such notice the terms of such agreement are not complied with, the Secretary will thereafter refuse to enter into any other cooperative agreement with such local authority until compliance has been made with the original agreement.

ACCOUNTING:

All Federal funds expended for road construction under the Act, and all cooperative funds which may be deposited in the United States Treasury in accordance with the Act of Congress approved June 30, 1914 (38 Stat. 415, 430), shall be disbursed as directed by the Secretary of Agriculture.

Cooperative funds used for the survey and construction of National Forest roads, but not deposited in the Treasury, shall be disbursed by the local authority only upon vouchers approved by the Office of Public Roads.

A separate account shall be kept, as directed by the Secretary, of all moneys disbursed for National Forest roads, showing the States and counties within which and the projects upon which such moneys have been expended, and the Secretary will furnish to the local authorities a detailed statement of such expenditures as soon as practicable after the completion of every project.

Unless otherwise directed by the Secretary, records of the costs of surveys and construction of all road projects, whether cooperative or National Forest roads, shall be kept upon forms to be supplied by the Office of Public Roads. If the Secretary shall so direct, progress statements or reports shall be submitted from time to time to the Office of Public Roads on forms supplied by that Office, and within ninety days after the completion of a project the local authority shall submit to the Secretary a final report of the project on a form supplied by the Office of Public Roads.

Immediately upon the execution of a cooperative agreement, the Secretary will notify the Secretary of the Treasury of the amount to be expended by the United States within or adjacent to any National Forest thereunder, and upon the completion of each project and the closing of the project accounts relating thereto, the Secretary will submit to the Secretary of the Treasury a statement of the total expenditures of Federal funds made on account thereof, and the distribution of such expenditures to each National Forest concerned.

ODOT LIBRARY
00006816

OR/
ODOT
INSTRUC
1919

Manual of
instructions to
department employees

OR/
ODOT
INSTRUC
1919

Manual of
instructions to
department employees

DATE	ISSUED TO

Oregon Department of Transportation
Library/Information Resource Center
355 Capitol Street NE, Rm 22
Salem, OR 97301-3871

DEMCO